# AALTO UNIVERSITY

School of Engineering
Department of Engineering Design and Production


# Improving Availability of Spare Parts in China and the Nearby Pacific Asia Region

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**Abstract of Master's Thesis**

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## Abstract

The purpose of this thesis is to evaluate possibilities of improving availability of spare parts in China and the nearby Pacific Asia region as the installed base is growing rapidly. This study is done for the ABB Marine Spare Parts department located in Helsinki Finland.

To evaluate the possibilities we provide an understanding of the logistics environment in the Pacific Asia region and present the fundamentals of spare parts supply chain management. The data is gathered from recent literature, statistics, and conducted interviews with industry professionals with experience working in the region.

Although the installed base is the largest in China, it is also the most challenging in terms of logistics with the highest customs barriers and tariff rates. We propose a model where a regional warehouse is set up in China where customs would not interfere with parts for further re-export by utilizing free trade zones while still serving the domestic market in the most cost and time efficient way. Finally, we compare this model with an alternative solution where the regional warehouse is set up in a different location in Pacific Asia.

**Keywords** Spare Parts, Supply Chain Management, Logistics, China, Pacific Asia, Warehouse

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**Diplomityön tiivistelmä**

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**Tiivistelmä**

Tämän tutkimuksen tarkoitus on vertailla mahdollisuuksia parantaa varaosien saatavuutta Kiinassa ja sen lähialueella Itä-Aasiassa laitakannan kasvaessa etenkin Kiinassa. Tämä tutkimus on tehty ABB Marinen Varaosaosastolle.

Jotta voimme vertailla mahdollisuuksia saatavuuden parantamiseksi, selvitämme ensiksi varaosien toimitusketjun tärkeimmät piirteet sekä esittelemme Itä-Aasian ja relevanttien maiden logistiikkapiirteitä sekä –säädöksiä. Esitelty data perustuu aihetta käsittelevään kirjallisuuteen, tilastoihin sekä haastatteluihin alan ammattilaisten kanssa, joilla on työkokemusta ja osaamista Itä-Aasian alueelta.

Vaikka Kiinassa on alueen suurin laitekanta, on maa silti logistiikan saralla verrattuja maita jäljessä. Hitaat tullimenettelyt ja korkeat tullaushinnat tekevät osien liikkumisesta haastavaa ja kallista. Tässä tutkimuksessa ehdotamme mallia, jossa varasto sijoitetaan Kiinaan vapaakauppa-alueelle, jotta edelleenvietävien sekä Kiinan sisäisille markkinoille tarkoitettujen osien tullimenettelyt sekä tullausmaksut minimoidaan. Lisäksi vertaamme mallia ratkaisuun, jossa varasto sijoitetaan johonkin muuhun Itä-Aasian valtioon.

**Avainsanat** Varaosat, Toimitusketju, Logistiikka, Kiina, Itä-Aasia, Varastot

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Signature:

Jermu Juntunen

Espoo 16.12.2014

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# 1 Introduction

## 1.1 Thesis Background

The installed base volumes have grown exponentially in recent years in Asia, especially in China. In addition to the newly-built vessels, American and European cruise lines are also increasing their presence in the region as the cruising industry has been growing in Asia recently. Also increasing gas transportation from Russia particularly to Japan is leading to increasing amounts of installed base operating in the area.

As the amount of operating Azipod vessels increases in Pacific Asia, the planning of the supply chain of spare parts is growing in importance to maintain a high global service rate and customer satisfaction. This thesis will evaluate possibilities of ABB Marine to improve the availability of spare parts in China and the nearby Pacific Asia region.

The author of this thesis has been working at ABB Marine Spare Parts since 2012 alongside his studies at Aalto University. The author also spent one semester studying at the Fudan University in Shanghai, China.

### 1.1.1 ABB Marine

The ABB Marine & Cranes unit in Helsinki, Finland develops electrification and automation solutions for the marine industry. The unit's cutting edge product is the Azipod electric propulsion system that improves fuel and energy efficiency as well as the drivability of the vessel. Azipods are installed on vessels such as cruise ships, icebreakers, tankers, wind turbine installation vessels, ferries, offshore supply vessels and mega yachts. In addition ABB Marine provides energy efficiency and advisory systems that minimize fuel costs, maximize ship availability and improve safety. (ABB, June 2012)

**Figure 1**. Example of the Azipod, an electric propulsion system. (ABB, June 2012)

The ABB Azipod, example seen in Figure 1, is and azimuthing electrical podded drive used in diesel-electric vessels. The Azipod unit is fixed in a pod outside the ship and it combines the functions of a propulsion motor, main propeller, rudder and stern thruster. A vessel equipped with Azipod units can save fuel up to 20 percent compared to standard mechanical propellers. The fuel savings are based on the smooth flow of water in the propellers. The 360 degree control of the Azipod allows better steerability to the ship and it is quieter and use of space inside the ship is more effective. Compared to a conventional propeller system in a typical Baltic ferry with car-carrying capability, the system can reduce carbon dioxide emissions by around 10 000 tons per year. (ABB, June 2012)

The innovation was introduced for the first time in 1990, in a pilot installation for a Finnish fairway maintenance vessel, and was later installed in few icebreakers and ice-going vessels. The first cruise vessel installation was completed in 1998 on a Fantasy-class cruise ship named Elation. Elation displayed remarkably positive results, including high efficiency and excellent maneuverability compared to previous Fantasy-class vessels. In addition the new technology provided ship designers greater freedom to optimize the ship's general structure. (ABB, June 2012)

There are different Azipod types in the product family depending on the operating conditions and power range. The Azipod VO, XO and CO types are open water applications. The XO is the new generation of open water applications, as the VO represents the older generation. The target of the new generation Azipod has been to extend docking intervals and increase the maintainability from the inside, as well as improving efficiency. These types operate in the power region up to 20 + MW. The CO Azipod is a smaller compact Azipod for small and medium size vessels and it operates on the power range of 1.3 to 4.5 MW. The Azipod VI is an ice application for different in-ice operating vessels, such as icebreakers, on the power range of 0.5 to 16 MW. Azipod XC is a contra rotating application for high speed vessels with up to 100 MW total propulsion power. Azipod CZ for drilling rigs are open water applications with thrust up to 60-84 tons/unit. With the power range of 3.3 to 4.5 MW the CZ has a pushing propeller with a nozzle. Examples of the various Azipod types can be seen in Figure 2. (ABB, June 2012)

**Figure 2**. Different types of Azipods. In the top left corner the Azipod CO, in the top right corner the Azipod VI, in the bottom left corner the contra rotating Azipod XC and in the bottom right corner the Azipod CZ. (ABB, June 2012), edited by J. Juntunen

## 1.2 Objectives

The objective of this thesis is to improve the availability of spare parts in China and the nearby Pacific Asia region. In addition the target is to advance the knowledge about the logistic and cultural characteristics in the region and develop a better understanding of the possibilities and opportunities regarding logistic solutions.

The main focus will be on China's logistics and the possibility of having a warehouse located in China that could serve the entire Pacific Asia region. Furthermore we compare nearby countries' logistic and regulations with China and attempt to evaluate if a different location would be better suited to serve the entire region than China. In addition we try to evaluate if a centralized warehouse model is convenient for this area and try to assess contradictions for this approach.

The results are intended to support future logistic strategy decisions made by the company, by providing key logistic focal points of the region and raise issues that need to be addressed. Furthermore the thesis seeks to provide out-of-the-box thinking regarding logistic solutions, which attempt to provide further perspective for the company's decisions making.

## 1.3 Problem defining

In this thesis we define availability as having critical spare parts ready for urgent shipments in such way that the parts can reach the operating installed base immediately. This means researching such focal aspects as how country borders and regulations interfere and trouble the movement of goods and other relevant matters.

The location is evaluated through comparing overall logistic performance and regulations between the countries rather than finding exact coordinates for a warehouse based on the amount of customers and installed base.

The examined region for this thesis is the Pacific Asia region where installed base of ABB Marine operates. More specific countries with ABB Marine sales offices and major ports are

examined and compared with China as possible locations for a central warehouse serving the region. These countries are Singapore, Japan, Hong Kong and the Republic of Korea (known as South Korea in the common language).

Even though Hong Kong is in principle not a country but a special administrative region, in this thesis when we refer to *countries of the defined region* we include Hong Kong in this list as an individual country as it has its own trading regulations and characteristics. This thesis does not take any political stance what so ever, this simplification is rather to form the text more simple to read.

## 1.4 Research methods

This research is primarily based on conducted interviews and data found in literature and official statistics, which are compared with each other in the analysis part of the thesis. Installed base and Azipod data is gathered from unclassified ABB material of whose publishing will not provide any competitive advantage or disadvantage to competitors, clients, or suppliers.

As for the interviews, ABB employees in China as well as employees in Finland who have previously worked in China and the Pacific Asia region were interviewed. Data was gathered also during development workshops between ABB China and ABB Finland. To give more cross-cultural perspective an industry professional outside of ABB, a supply chain manager from Valmet China, was interviewed.

## 1.5 Structure

After the introduction part the thesis is built into three parts as displayed in Figure 3:

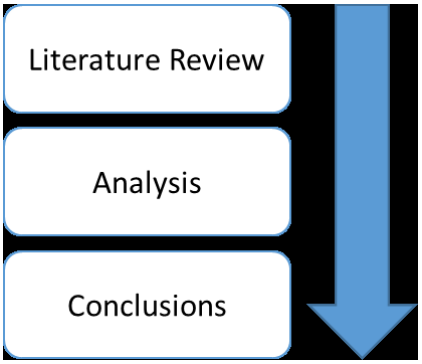


**Figure 3.** Structure of the thesis.

The literature review part of this thesis is presented in chapters 2 and 3. Chapter 2, *Spare Parts Supply Chain Management,* is a review on recent literature regarding spare parts logistics and supply chain management. This chapter will give an overview on the challenges and needs that need to be taken into account in building a successful logistic strategy for spare parts. Chapter 3, *Logistic Characteristics of Pacific Asia,* provides knowledge and statistics of the logistics environment in the defined countries for this thesis. Additionally in this chapter we take a deeper look into the logistics in China and the basic cultural characteristic of operating in China. The objective of these chapters is to give a foundation for the analysis and raise important aspects that need to be taken into account.

Chapter 4 and 5 form the analysis part. Chapter 4, *Volume of Installed Base,* assesses the volume of operating installed base in the region and analyses the variation of Azipod types. Chapter 5, *Availability Planning in Pacific Asia,* is based on all of the previous chapters. In this chapter we evaluate how to improve the availability of spare parts and compare the different locations. The argumentation is based on the fundamentals and statistics provided in the literature review, installed base volume analysis, and conducted interviews.

The conclusion part of the thesis consists of chapter 6 and 7. In chapter 6, *Conclusions* we present the essential results and evaluate them. In chapter 7, *Follow-Up Actions and Recommendations* we suggest further actions for the solutions to be taken into practice.

# 2 Spare Parts Supply Chain Management

Spare parts are parts and equipment that are completely interchangeable with like items and can be used to replace items removed during maintenance and are only demanded after primary products have been sold (Wagner, et al., 2012).

The characteristics of spare parts supply chain management differs from those of other materials in several ways. First of all the demand for parts may be extremely sporadic which leads to difficulties in estimating demand. In addition service requirements are higher as the stock out costs may be financially remarkable. The number of part types is usually high and the prices of individual parts may be extremely expensive. As a result, companies may keep a large spare parts inventory, while the annual inventory may be very low. (Huiskonen, 2001)

In this chapter we take a closer look in literature regarding spare parts supply chain management. The purpose is to provide an understanding of the business environment and challenges needed to be taken into account in constructing logistic strategies for spare parts operations.

## 2.1 Spare Parts Logistics

Companies with a well-aligned spare parts logistics strategy can add value for their customer beyond primary product benefits, build long term customer loyalty and achieve high profit margins. Companies across various industries recognize spare parts supply not only as an obligation, but as a chance to increase profits in their primary product markets. (Wagner, et al., 2012)

Wagner *et al*. define spare parts logistics as market-orientated planning, design, realization, and control of the spare parts supply and distribution, along with associated information flows within a firm and between the firm and its network partners (Wagner, et al., 2012). Therefore spare parts logistics aims at a demand-driven, cost-minimal provision of the

required spare parts for the defective or preventive maintenance of primary products to ensure an optimal level of availability or reliability of the product (Wagner, et al., 2012).

The challenges in spare parts logistics emerge mainly due to the combination of large service networks and sporadic demand. Also rigid deadlines and customer heterogeneity generate additional challenges. However, high revenue rates in service operations motivate companies to invest in optimizing and improving service functions and operation models. (Jalil, et al., 2011)

Gebauer *et al*. argue that spare parts logistics are influenced by the different requirements of the service strategies described as after-sales service providers and customer support service providers. (Gebauer, et al., 2011)

After-sales service providers react for example in the event of breakdown or failure as quick as possible to solve the problem. From a logistics perspective, after-sales providers are challenged with unpredictability and high customer expectations regarding delivery times. A common way to meet availability requirements and shorten delivery times is to have relatively high stock values. (Gebauer, et al., 2011)

Customer support providers on the other hand concentrate on preventing failures and breakdowns from happening in the first place. Preventive maintenance contracts include pre-defined spare parts, leading to predictable demand. (Gebauer, et al., 2011)

Wagner *et al*. offer a three-step model approach to spare parts logistics. The model is based on nine key components and is illustrated in Figure 4:

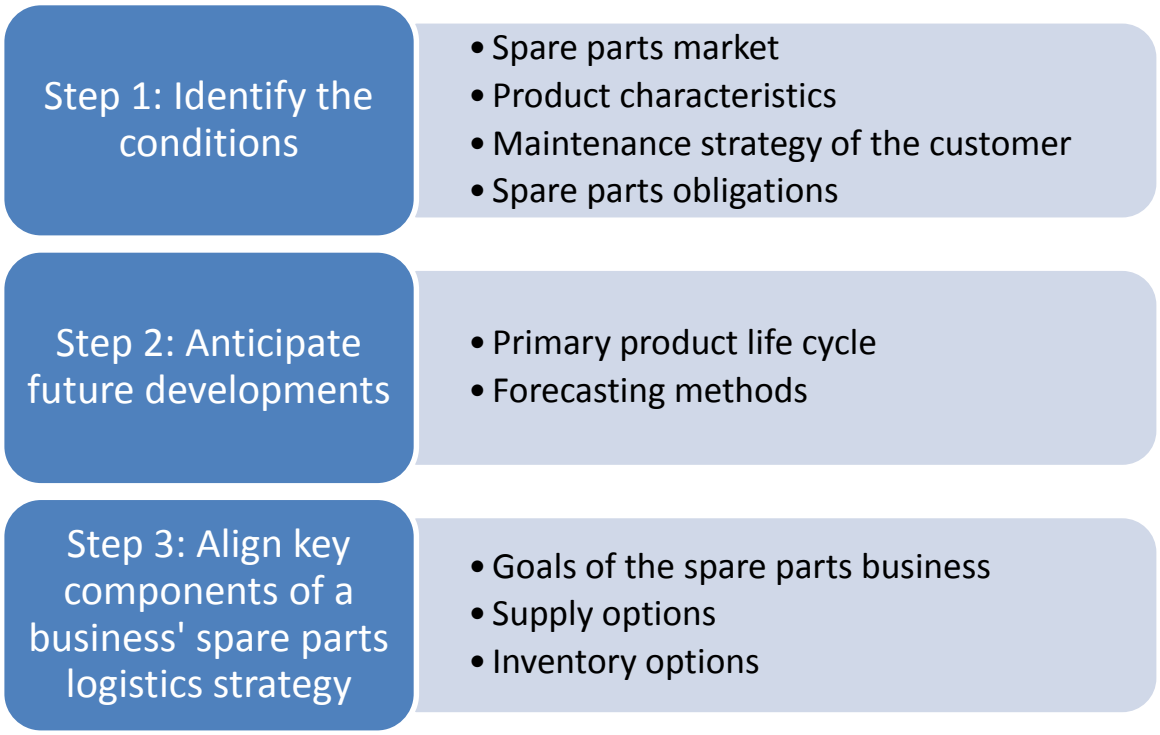


**Figure 4**. Three-step model for spare parts logistics strategy. (Wagner, et al., 2012), edited by J. Juntunen

The first step, identifying conditions, consists of four components: *Spare parts market*, *product characteristics*, *maintenance strategy of the customer* and *spare parts obligations*. The high profitable business of spares is attracting competitors to the market. However the distinctive specificities and varieties of each manufacturer's parts keep the entry barriers high. Wagner *et al*. argue that top performers are well informed about the portfolio and market shares of competitors. Another condition is the variety of products. Products have different requirements such as delivery time and demand. Better knowledge of the product sets a better strategic alignment of spare parts logistics. Maintenance strategies have direct influence on spares demand and therefore the knowledge of customer behavior is required to establish more accurate understanding of the conditions. The last condition of Step 1 is the spare parts obligations. Manufacturers may have legal obligations to deliver spares for example through triggered contractual agreements or warranty obligations. (Wagner, et al., 2012)

The second step in the model suggested by Wagner et al. is the anticipation of future developments through knowledge of *primary product life cycle* and *forecasting methods*. Understanding the product life cycle helps to improve the delivery service while decreasing logistic costs. Forecasting methods on the other hand help estimating demand and planning inventory. (Wagner, et al., 2012)

The final step of aligning key component consists of goals of the *spare parts business*, *supply options,* and *inventory options*. The spare part business of different companies may have different main goals or various goals. In addition to achieving revenues and profits companies may pursue targets such as customer loyalty or differentiation from competitors. Supply options are the strategic decisions of establishing distribution channels and networks. Inventory options contain decisions that influence stock levels, warehouse locations, degree of storage centrality and storage equipment. (Wagner, et al., 2012)

## 2.2 Part Categorization and Criticality

Huiskonen argues that spare parts should have a more specific categorization because of their effects on the characteristics of the logistic system. Huiskonen suggests that the most relevant characteristics are *criticality, specificity, demand pattern,* and *value*. (Huiskonen, 2001)

The *criticality* of an item is one of the main effects it has on the spare part chain. The criticality of a part is related to the consequences caused by the failure or malfunction of the individual part in case a replacement is not immediately available. The impact of a shortage of a critical part may be a multiple of its commercial value. One approach is to relate criticality to the time in which the failure has to be corrected: (1) The failure has to be corrected immediately and the spare part should be available on that instant. (2) The failure can be tolerated with temporary arrangements for a short time period, during which the spare part can be delivered. (3) The failure is not critical for the operation and spare parts can be supplied after a longer time period. (Huiskonen, 2001)

From the logistics and the availability point of view it is vital to know whether there is time to operate after the failure of a part. This dictates the positioning and availability of parts if a

certain service rate is to be achieved. In case of immediate need, local safety stocks are a safe approach to manage availability on that instant. With more time to operate companies may prefer more centralized structures with direct deliveries. (Huiskonen, 2001)

The *specificity* of a part is another characteristic of spare parts. Companies may have a wide spectrum of parts that can be divided into standard and more specific parts. Standard parts can be used for the majority of the installed base meaning that the individual part is the same model for many different users. In contrast more specific parts are tailored just for one particular user or for a limited number of installed based applications. (Huiskonen, 2001)

The *demand pattern* of a spare part includes the aspects of volume and predictability. It is typical that among the spare parts there is a large amount of different parts with low and irregular demand, which makes supply chain control more difficult. This feature leads to increasing the amount of safety stocks needed to cover unpredictable situations. Predictability of demand is related to possibilities to estimate failures and replacement needs of a single part. Parts can be divided into parts with random failures and parts with predictable wearing patterns. (Huiskonen, 2001)

The *value* of a part is a common characteristic where high value makes stocking a non-attractive solution. Furthermore with low price items the replenishment arrangements have to be efficient so that administrative costs do not increase unreasonably in proportion to the value of the parts themselves. (Gebauer, et al., 2011)

Cavalieri *et al*. provide a categorization based on the expected behavior of items. These four categories are *consumables and auxiliary materials*, *generic spare parts*, *specific spare parts*, and *strategic spare parts*. (Cavalieri, et al., 2008)

*Consumables and auxiliary materials* are items characterized by a steady and continuous consumption as well as having a large amount of supplier base. Examples are items such as filters and oils. *Generic spare parts* are items that can be mounted on more pieces of equipment. They are often widely available and examples of *generic spare parts* are valves, switches and hydraulic accessories. *Specific spare parts* are specific to a particular type of equipment or available only through a specific supplier. *Strategic spare parts* are items

whose expected wear-out time is not foreseeable and are characterized by high supply delivery times. (Cavalieri, et al., 2008)

## 2.3 Inventory Management

The materials held in storage to satisfy a future demand are called *inventory*. The location where the inventory is held is most of the time stationary and these are defined as *warehouses*. However inventories are sometimes held in the vehicles or on carriers of installed base such as airplanes and marine vessels to provide emergency spare parts immediately. (Goetschalckx, 2011) p431

Spare part inventories differ from other manufacturing inventories, such as *work-in-process* (WIP) and *final product* inventories, in several ways. WIP inventories exist to smooth out irregularities in production flow which can be caused for example by changes in product mix, equipment breakdowns, material handling and differences in production rates between different processes. Finished product inventories on the other hand exist to provide a source of products for delivery and are designed to protect against irregularities in lead time demand, differences in quality levels, schedule problems, differences in capacity and demand, labor problems and other characteristic production problems. Spare parts however are not intermediates of final products. Spare part inventories exist mainly to keep equipment in installed base in operating condition. (Kennedy, et al., 2002)

Spare part inventories consist of items that are replacement parts for specific installed base and serve as protection against prolonged downtimes and equipment failures. These inventories tend to be relatively expensive compared to other manufacturing inventories as demand is more difficult to forecast and since the items are to replace a part in the installed base, they may just sit in the inventory if the part is not required to be replaced, meaning that there is no alternative use for the items as they serve as insurance against system downtimes. (Kennedy, et al., 2002)

Spare parts are usually stocked as it is often difficult to obtain the items from the suppliers on short notice and some parts are critical for system operations leading to expensive system

downtimes. Therefore stocking levels are determined by balancing risk and cost impacts. In addition the risk of obsolescence may be a problem for parts that are rarely needed compared to parts whose use is directly related to repetitive maintenance and the short- and mid-term usage is predictable. (Kennedy, et al., 2002)

One characteristic of spare part inventories is that maintenance policies dictate inventories levels, rather than customer usage. For example one way of restoring system functionalities is to repair a part instead of replacing it. For expensive major units repair is commonly preferred to replacement if it is possible. (Kennedy, et al., 2002)

## 2.4 Demand Forecasting

Supply chain planning and design involves making decisions so that the supply chain functions can be executed efficiently in the future. Therefore planning and design of the supply chain requires data that describes the future conditions as accurately as possible. Demand predictions and forecasts are crucial for establishing inventories that make supply chains more efficient and profitable. (Goetschalckx, 2011) [ p.65-67]

For generating quality forecasts it is fundamental to understand the pattern of the demand. Depending on the behavior over time, the pattern can be classified as *regular* or *irregular*. If the pattern is regular, future values can be predicted based on historical data. Accurate forecasts can be achieved by mathematical forecasting methods such as regression and time series analysis. If the pattern is irregular, singular occurrence, intermittent, or highly variable, accurate forecast are far more difficult to obtain with mathematical methods. (Goetschalckx, 2011)[ p.65-67]

Forecasting methods can also be classified as *quantitative* or *qualitative*. Qualitative forecasting methods use experts, subjective judgment, intuition, or surveys to produce estimates and predictions of future activity. The subjective nature of these methods makes it difficult to validate the accuracy. Qualitative methods are primary used for a new product, new areas, impact of a policy change or impact of new technology. Quantitative methods on the other hand rely on models using historical values to predict future demand. To establish

accurate quantitative forecasts sufficient historical data is required and the market environment needs to be familiar. (Goetschalckx, 2011) p.65-67]

Spare parts demand can show different diversified patterns, depending of the type of the part considered and the specific industry. Spare parts demand is often characterized as sporadic, where demand sizes and demand intervals have great variability. Spare parts demand can be forecasted with various methods and models. According to Altay and Litteral two primary classes of techniques are:

1. *Reliability based forecasting* (RBF). Used when installed base and their technical operating conditions are known.
2. *Time series forecasting* (TSF). Suitable when the only available data is related to time series of the spare parts consumptions or repair records, while no information about the reliability of the installed base is on hand. [ (Altay & Litteral, 2011) p.177-179]

RBF methods are based on data devoted to collect the failure rates of different items and their typologies. The data is based on knowledge of the conditions of use and the required performance and duty cycles of the item. Methods can also be based on the life data analysis of items. Forecasts are based on statistical analysis of historical failure rates or reliability tests. [ (Altay & Litteral, 2011) p.177-179]

Methods of TSF are based on the analysis of orders issued for spare parts, either the repair orders of existent items or the supply orders of new spares. Demand patterns can be estimated with analyzing distributions. [ (Altay & Litteral, 2011) p.177-179]

## 2.5 Spare Parts Business Planning

Spare parts business faces a lot of challenges in forecasting demand, planning inventory and distribution, and improving the agility of the supply chain. Deloitte suggests companies building and developing spare parts business to first take action to define the spare parts planning management structure, as demonstrated in Figure 5. The planning structure can be divided into three main levels: *tactical planning*, *operative planning,* and *planning execution*. (Deloitte, 2013)

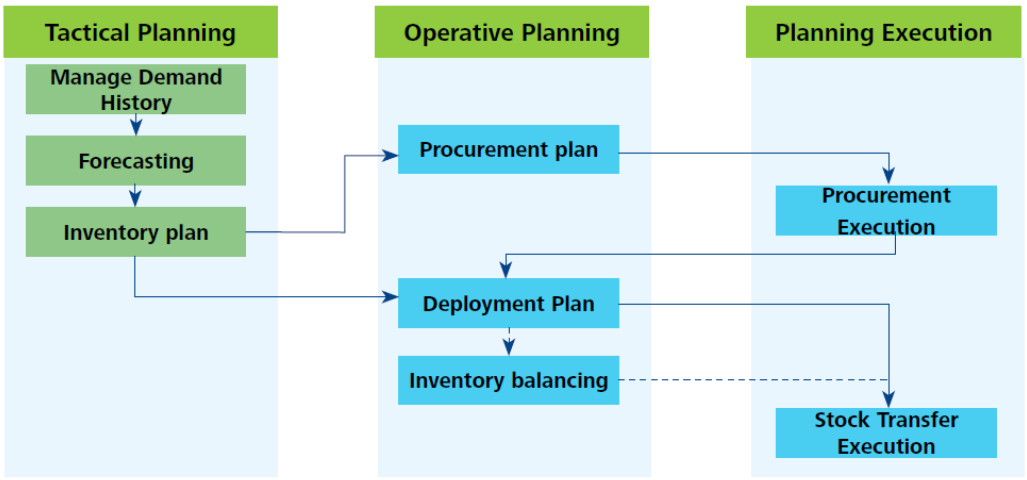


**Figure 5.** Spare parts planning management structure. (Deloitte, 2013)

The tactical planning consists mainly of historical demand management, forecasting demand and inventory planning management. This planning level is determining stocking or destocking and inventory levels for each site of the distribution network. (Deloitte, 2013)

Operative planning is determining the real goods flow, including the flow from suppliers to central warehouses and from central warehouses to regional distribution channels. Operation planning can therefore be divided into three main aspects: procurement plan, deployment plan and inventory balancing. (Deloitte, 2013)

Planning execution consists of procurement execution and stock transfer execution. According to Deloitte the lead times of procurement and stock transfers are key inputs to inventory planning. Short and stable lead times will reduce the inventory levels in the entire network. (Deloitte, 2013)

## 2.6 Spare Parts Supply Chain Framework

Spare parts business can be a highly profitable source for manufacturing companies by optimizing operations, careful planning, and continuous improvement of the supply chain network. Deloitte suggests a spare parts supply chain management framework, which consists of twelve key capabilities for spare parts management as illustrated in Figure 6. These capabilities can be divided into four fundamentals: *foundations*, *enablers*, *execution processes,* and *results*. (Deloitte, 2013)

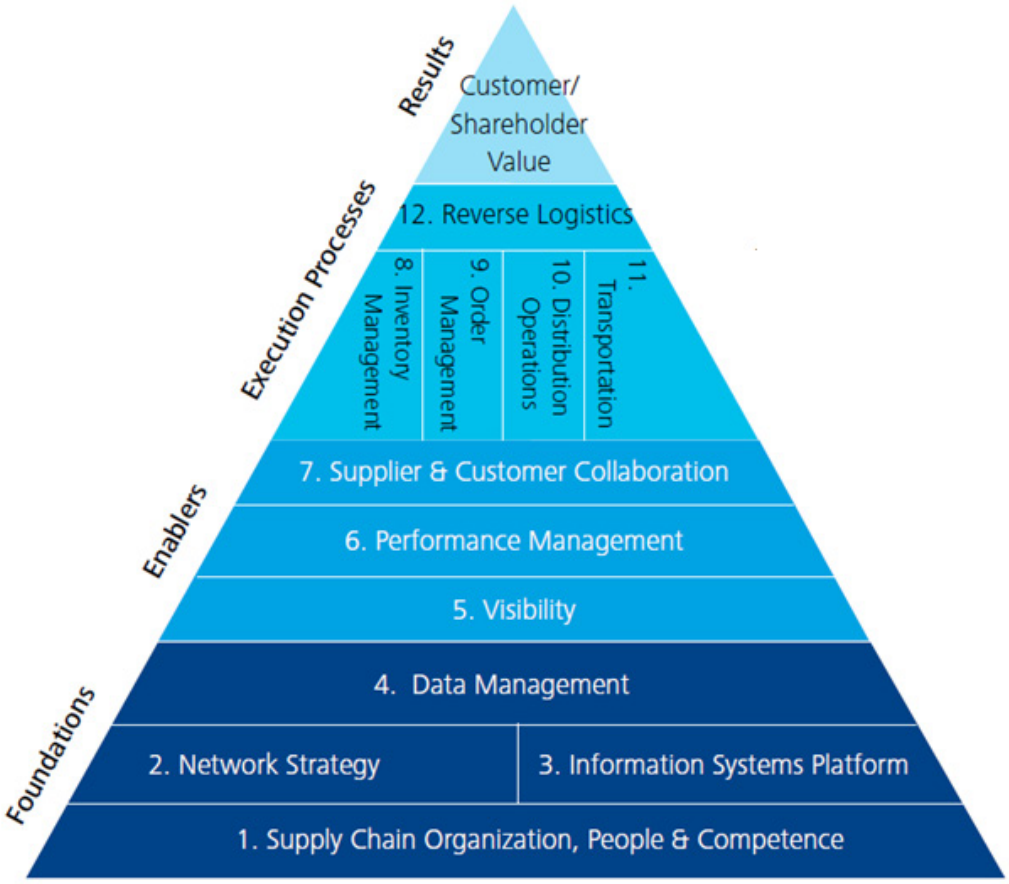


**Figure 6**. Framework of 12 key capabilities for spare parts supply chain management. (Deloitte, 2013)

The foundation consists of the organization, people, information systems, and data management. Problems in these foundational elements lead to further problems in successfully achieving upper layers of the framework. Enablers of the spare parts supply chain are visibility, performance measurement and supplier and customer collaboration. The

capabilities can improve the supply chain execution process and strengthen its functionalities through the entire network. The core execution processes are inventory management, order management, distribution operations and transportation. These processes have a direct impact on the results and performance of the overall spare parts supply chain. The top layer of the spare parts supply chain pyramid represents the results which aim to create value for the customer and stakeholders. This is the starting point of establishing supply chain strategy and the final output of the spare parts supply chain. (Deloitte, 2013)

The suggested framework gives an understanding between correlations of the different aspects and fundamentals of the spare parts supply chain. It is built to help companies to achieve long-term optimizations in spare parts management and identify opportunities and possible reforms in the current structure of the spare parts business. (Deloitte, 2013)

Cavalieri *et al*. suggest a decision-making framework for managing spare parts consisting of five sequential steps: *part coding*, *part classification*, *part demand forecasting*, *stock management policy*, and *policy test and validation*. The framework is presented in Figure 7.

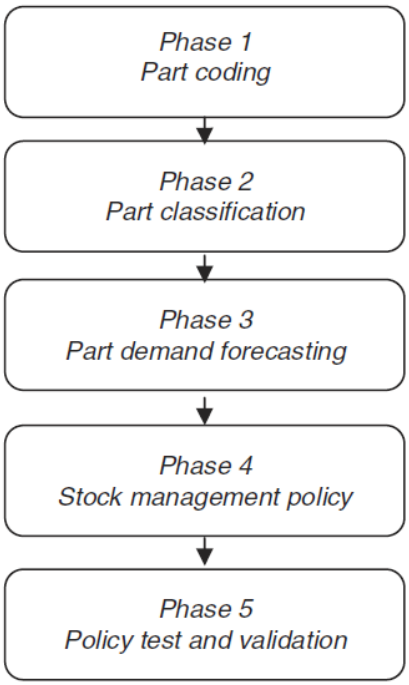


**Figure 7.** The five decision making steps. (Cavalieri, et al., 2008)

The first phase, part coding, should provide a prompt understanding of the technical features, the equipment tree it refers to, the involved supplier, and the physical location in the storage. However the common modern ERP-systems provide the needed information of items. The second phase indicates that items need proper classification as there is a high variety of criticality, repair purposes and economical features. The third phase involves part demand forecasting through quantitative and qualitative methods. The fourth phase of stock management policy refers to decisions made considering inventory levels using approaches such as EOQ or ROL. The last phase is the policy test and validation of the results achieved after applying the earlier steps of the framework. (Cavalieri, et al., 2008)

## 2.7 Managing Growth of Spare Parts Business

For OEMs (Original Equipment Manufacturers) in more mature markets such as the US and Europe spare part business has already become one of the most important sources of revenue. According to global survey conducted by Deloitte, service and spare parts business account for more than 35% of total revenues in vehicle sales (Deloitte, 2013). For third of the OEMs, the revenue generated contributes even more than 50% of total revenue. In addition profit margins for the spare part business are 76% higher than that of conventional finished products. (Deloitte, 2013) According to the experiences of leading OEMs in mature markets, the spare part business experiences three common stages: initial growth, rapid development, and maturity. Aligned with these development stages, spare parts management has also experienced transformation in three modes (illustrated in Figure 8): basic management mode, network management mode, and integration management mode. (Deloitte, 2013)

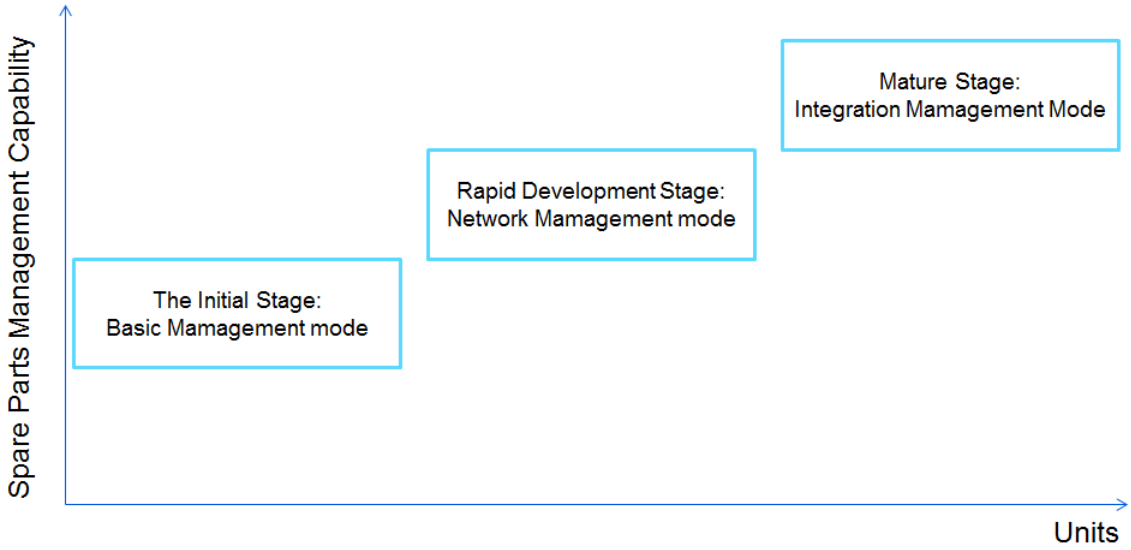


**Figure 8.** Three stages of spare parts management capability. (Deloitte, 2013), edited by J. Juntunen

In the initial stage the most important target is to guarantee the parts supply. Due to limited business size supply chain operations cannot achieve economies of scale and on time delivery is difficult to guarantee. The focus lies in building the basic operation structure. (Deloitte, 2013)

In the next stage of rapid development the client base expands and the spare part business is undergoing exponential growth. The focus of this stage is the improvement of service quality and customer satisfaction. The service level of the spare part business is stabilized through the establishment of a distribution network. (Deloitte, 2013)

By reaching the mature stage, spare part business becomes one of the key sources of revenue and profits. In this stage the main objectives become reducing operating costs and increasing profits. The key tasks are improving the agility of the supply chain, increasing collaboration of the entire supply chain and integration of a global distribution network. (Deloitte, 2013)

# 3 Logistic Characteristics of Pacific Asia

The purpose of this chapter is to provide an understanding of the logistics characteristics and regulations of the defined region relevant for this thesis. This chapter displays the logistic performance of the countries to give an overall view on the competence and challenges of the different locations. Additionally we present levels of average rents and salaries and furthermore take a look into customs procedures to display the barriers caused by international borders.

We take a closer in depth look at the logistics and the logistics development of China as one goal of the thesis is to evaluate the possibility of utilizing China as the regional logistics hub. In addition we display common cultural characteristics to provide a better knowledge of business conditions to manage cultural differences more efficiently.

## 3.1 Country Specific Logistic Performance

The World Bank has produced since 2007 every two years a *Logistics Performance Index* (LPI), which measures logistics performance of individual countries, including 160 countries in 2014. The aim is to help national leaders, key policy makers, and private sector traders to understand the challenges they and their logistic partners face. The LPI provides a simple global benchmark to measure logistics performance by providing comparisons between countries. The LPI is built around surveys of logistic professionals and rates key issues such as customs clearance efficiency, infrastructure quality, and the ability to track cargo.

In this chapter we present the logistics performances of countries relevant for this thesis. The countries are China, Japan, Republic of Korea, Singapore and Hong Kong.

### 3.1.1 Country Score Cards

The international country specific scorecards are constructed using six key dimensions to benchmark a country's performance and display also the derived overall LPI index. The six core components are:

1. The efficiency of customs and border management clearance
2. The quality of trade and transport infrastructure
3. The ease of arranging competitively priced shipments
4. The competence and quality of logistic services
5. The ability to track and trace consignments
6. The frequency with which shipments reach consignees within scheduled or expected delivery times. (The World Bank, 2014)

The international LPI is based on surveys where its respondent rates eight overseas markets. The eight markets are chosen based on the most important import and export markets of the country where the respondent is located, neighboring countries that form part of the land bridge connecting them with international markets, and on random selection. The method used to select the group of countries rated by each respondent varies by the characteristics of the country and takes also into account factors such as income of the country and if countries are coastal or landlocked. The six key components are rated by the respondents from *very low* (1) to *very high* (5). (The World Bank, 2014)

The overall LPI score is constructed by multiplying the normalized scores for each of the six components with the component loadings, displayed in Table 1, and then summed together. The component loadings represent the weight given for each of the components in constructing the overall LPI. (The World Bank, 2014)

| Component | Weight |
|---|---|
| Customs | 0.40 |
| Infrastructure | 0.42 |
| International shipments | 0.40 |
| Logistics quality and competence | 0.42 |
| Tracking and tracing | 0.41 |
| Timeliness | 0.40 |

**Table 1**. Weight of the individual components on the overall logistics performance index. (The World Bank, 2014)

The scorecards are presented in Figure 9 in a diamond diagram. The diamond is heptagon shaped where the top corner represents the overall LPI score and the remaining six corners represent the six key components. Table 2 displays the detailed values in each category. The table is ranked from highest to lowest depending on the overall LPI score. Table 2 also indicates the global ranking of compared countries. (The World Bank, 2014)

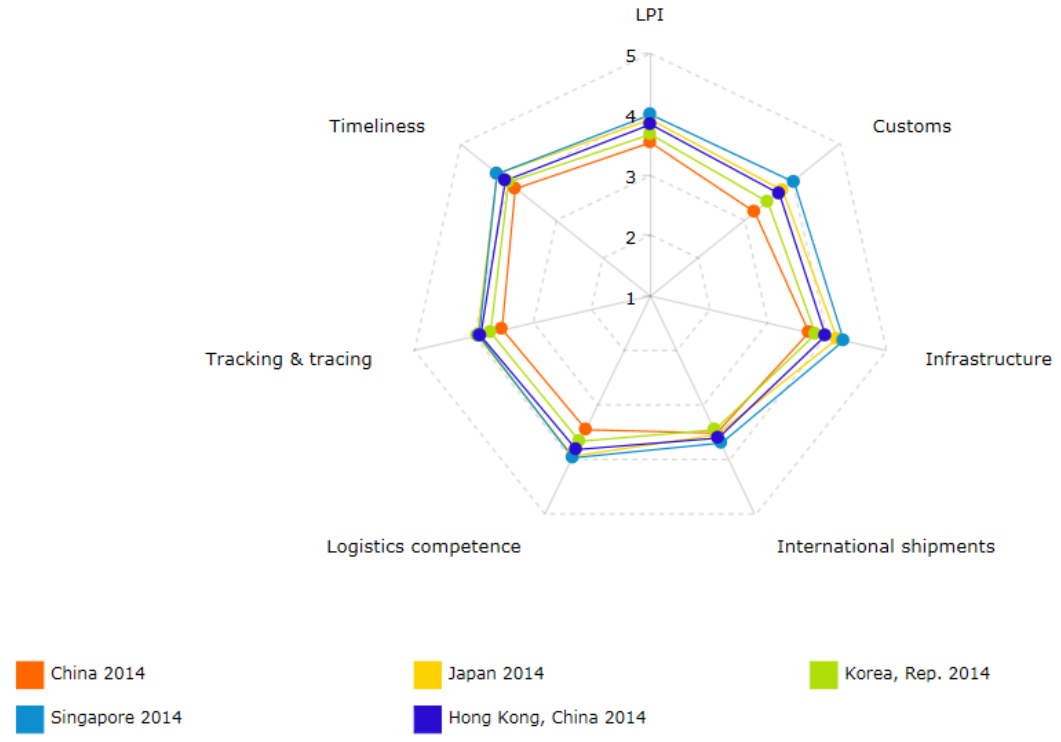


**Figure 9**. Diamond diagram of the logistics performance of the compared countries. (The World Bank, 2014)

| Country | Year | LPI Rank | LPI Score | Customs | Infrastructure | International shipments | Logistics competence | Tracking & tracing | Timeliness |
|---|---|---|---|---|---|---|---|---|---|
| **Singapore** | 2014 | 5 | 4.00 | 4.01 | 4.28 | 3.70 | 3.97 | 3.90 | 4.25 |
| **Japan** | 2014 | 10 | 3.91 | 3.78 | 4.16 | 3.52 | 3.93 | 3.95 | 4.24 |
| **Hong Kong, China** | 2014 | 15 | 3.83 | 3.72 | 3.97 | 3.58 | 3.81 | 3.87 | 4.06 |
| **Korea, Rep.** | 2014 | 21 | 3.67 | 3.47 | 3.79 | 3.44 | 3.66 | 3.69 | 4.00 |
| **China** | 2014 | 28 | 3.53 | 3.21 | 3.67 | 3.50 | 3.46 | 3.50 | 3.87 |

**Table 2.** Table with exact scores of the logistics performance of the compared countries. (The World Bank, 2014)

As seen in Table 2 Singapore ranks best in the overall LPI score ranking globally fifth, reaching highest scores in every category among countries selected for this thesis. Japan ranks second over third ranked Hong Kong and fourth ranked Republic of Korea. China ranks last among the selected countries and 28$^{th}$ globally. China scores worst in every category except for international shipments where it scores 0.06 higher than the Republic of Korea. (The World Bank, 2014)

### 3.1.2 Domestic LPI

In the survey for domestic LPI, respondents provide qualitative and quantitative data on the logistics environment in the country they work. Table 3 displays the results of the research for the countries relevant to this thesis:

| | China | Japan | Korea, Rep. | Singapore | Hong Kong |
|---|---|---|---|---|---|
| **Export time and cost / Port or airport supply chain** | | | | | |
| Distance (kilometers) | 198km | 25km | 300km | 30km | 36km |
| Lead time (days) | 2 days | 2 days | 1 days | 2 days | 1 days |
| Cost (US$) | 494US$ | 500US$ | 500US$ | 323US$ | 194US$ |
| **Export time and cost / Land supply chain** | | | | | |
| Distance (kilometers) | 248km | N/A | N/A | 31km | 43km |
| Lead time (days) | 2 days | N/A | N/A | 2 days | 1 days |
| Cost (US$) | 683US$ | N/A | N/A | 909US$ | 194US$ |
| **Import time and cost / Port or airport supply chain** | | | | | |
| Distance (kilometers) | 172km | 25km | 300km | 25km | 43km |
| Lead time (days) | 3 days | 2 days | 1 days | 2 days | 1 days |
| Cost (US$) | 683US$ | 750US$ | 500US$ | 266US$ | 211US$ |
| **Import time and cost / Land supply chain** | | | | | |
| Distance (kilometers) | 137km | N/A | N/A | 31km | 43km |
| Lead time (days) | 2 days | N/A | N/A | 2 days | 1 days |
| Cost (US$) | 514US$ | N/A | N/A | 783US$ | 194US$ |

**Table 3.** Comparison of lead times, average distances, and costs.
(The World Bank, 2014), edited by J. Juntunen

Table 3 distinguishes export and import and the supply of goods through ports and airports or via land supply, hence the table is divided into four main categories: export time and cost for port and airport supply chains, export time and cost for land supply chains, import time and cost for port and airport supply chains, and import time and cost for land supply chains. The four main categories are divided further into three subcategories: distance, lead time, and cost. Export time and cost for port and airport supply chains refer to the goods movement from origin, for example the seller's factory, to the port of loading or equivalent, as the import time and cost for port and airport supply chain refer to the movement of goods from the port of discharge or equivalent to the buyer's warehouse. Both the export and import time and cost for land supply chains refer to the movement of goods from the point of origin to the buyer's warehouse. (The World Bank, 2014)

Country scores for distance are displayed in kilometers, lead time in days and costs in US Dollars. Scores are produced by exponentiating the average of responses in logarithms across all respondents for a given country. Japan and the Republic of Korea do not have any values for land supply as Japan is not landlocked with any country and the Republic of Korea is only landlocked with North Korea through which commercial goods of international trade are generally not transported. (The World Bank, 2014)

Table 4 displays the shipment quality, customs clearance processes, and lead times:

| | China | Japan | Korea, Rep. | Singapore | Hong Kong |
|---|---|---|---|---|---|
| **Shipments meeting quality criteria (%)** | 75.68% | 89.46% | 97 % | 92.47% | 95.17% |
| **Number of agencies - exports** | 3 | 7 | 2 | 1 | 4 |
| **Number of agencies - imports** | 3 | 7 | 2 | 1 | 4 |
| **Number of documents - exports** | 4 | 3 | 2 | 1 | 4 |
| **Number of documents - imports** | 5 | 3 | 2 | 1 | 4 |
| **Clearance time without physical inspection (days)** | 2 days | 1 days | 1 days | 0 days | 0 days |
| **Clearance time with physical inspection (days)** | 3 days | 1 days | 1 days | 1 days | 1 days |
| **Physical inspection (%)** | 6.72% | 2.5% | 18 % | 4.82% | 1 % |
| **Multiple inspections (%)** | 2.24% | 1 % | 18 % | 2.86% | 1 % |

**Table 4.** Comparison of shipment quality, customs simplicity, customs clearance times, and ratios of physical inspections of goods. (The World Bank, 2014), edited by J. Juntunen

The shipment meeting quality criteria row in Table 4 indicates how many percentages of the shipments meet the required quality criteria. Table 4 displays also how many government agencies are dealt with and how many documents are required for import and export on average. The clearance time rows indicate how many days are taken between the submission of an accepted customs declaration and notification of clearance with either physical inspection or without physical inspection. Table 4 also displays the percentage of experienced physical inspections of goods and percentage of goods going through multiple inspections. (The World Bank, 2014)

### 3.1.3 Tariffs and Logistic Costs

The Global Enabling Trade Report 2014 published by the World Economic Forum benchmarks trade and logistic competitiveness between 137 economies. Table 5 displays the average tariff rates and all the costs associated with the procedures required to import and export goods. These include costs for documents, administrative fees for customs clearance and technical control, terminal handling charges and inland transport. The cost measure does not include tariffs or trade taxes and only official costs are recorded. This indicator measures the fees levied on a 20-foot container in US Dollars. (Hanouz, et al., 2014)

| Country | Cost to import (US $ per container) | Cost to export (US $ per container) | Tariff rate (%) |
|---|---|---|---|
| China | 615 | 620 | 11,09 |
| Hong Kong SAR | 565 | 590 | 0,00 |
| Japan | 970 | 890 | 2,15 |
| Korea, Rep. | 695 | 670 | 8,50 |
| Singapore | 440 | 460 | 0,03 |

**Table 5**. Average cost for import and export of goods for a 20-foot container and average tariff rate. (Hanouz, et al., 2014)

### 3.1.4 Warehouse Price Levels

In this chapter we take a look inside the average warehouse rentals and salaries. Table 6 displays the average rents per square meter in US Dollars per annum. As warehouses also demand workforce, therefore Table 6 displays the average annual wages of the relevant countries, to demonstrate the difference in income levels. The rents and salaries are representing averages from country capitals except China, where the values represent Shanghai's average prices.

| Country | Rental (US$/sqm) | Monthly wage (US$) |
|---|---|---|
| China | 51 | 333.30 |
| Hong Kong SAR | 200 | 1688.00 |
| Japan | 215 | 2818.40 |
| Korea | 58 | 2388.40 |
| Singapore | 126 | 2487.10 |

**Table 6**. Average rental prices for warehouses and average monthly wages. (NAI Global, 2011) (Trading Economics, 2014)

Also researches by CBRE state the average rent prices in the logistic market. According to CBRE Tokyo ranks the highest with the most expensive rents in 2012, Singapore third and Hong Kong fifth. CBRE's top 10 highest rent prices can be seen in Table 7:

| Markets | US$ PSF PA Equivalent |
|---|---|
| Greater Tokyo* | $23.28 |
| London | $19.61 |
| Singapore | $17.51 |
| Stockholm | $14.17 |
| Hong Kong | $12.84 |
| Sydney | $12.45 |
| Brisbane | $11.74 |
| São Paulo/Campinas | $11.71 |
| Perth | $11.02 |
| Paris | $10.76 |

**Table 7.** CBRE's top 10 rent prices in the logistics market 2012. (CBRE, 2012)

## 3.2 Logistics in China

After 15 years as a candidate, China was accepted in 2001 as a member of the WTO (World Trade Organization). Joining the WTO was a crucial event in Chinese economic history as it opened up China's markets for more international trade and investment, and opened the world economy more for China's exports. Before joining the WTO China was the world's seventh largest exporter and eighth largest importer of merchandise. By integrating fully into the global economy China has become the largest exporter and the second largest economy in the world. (Bhattasali, et al., 2004) (Qi, 2012)

To manage the logistic challenges and opportunities this chapter tries to provide the significant aspects of China's logistics characteristics. This chapter presents the development in logistic to give a better understanding of the challenges still faced in the current logistic environment. Additionally we display the fundamentals of importing and exporting in China, logistic approaches presented in literature, and special economic regions that can be utilized in building a logistic strategy.

### 3.2.1 World Trade Organization

The WTO was established in 1995 and its main functions are administering WTO trade agreements and monitoring national trade policies. It also provides a forum for trade negotiations and a platform for handling trade disputes. China was accepted as a member in 2001 through a lengthy process of negotiations and an agreement, *Protocol on the Accession of the People's Republic of China*, which included numerous provisions and requirements to changes in the Chinese economy. In this chapter we take a closer look inside the effects of China's WTO membership especially in the field of international trade and logistics. (World Trade Organization, 2011)

The accession agreement has opened China's sales, service and distribution sectors to direct foreign competition. China's biggest commitments are that foreign companies can distribute their products with their own warehousing and delivery facilities, the constraints on foreign

equity will be removed and logistic services such as local and international courier service, freight forwarding and distribution will be opened to foreign companies. (Jiang & Prater, 2002)

The easing of regulations in the logistic sector is a critical factor of simplifying distribution in China. It has required earlier owning multiple partners in different regions to establish a large distribution network. In addition more competition has had a reducing effect on logistic prices and puts pressure on improving efficiency. (Jiang & Prater, 2002) (Bhattasali, et al., 2004)

The requirements in the Protocol on the Accession of the People's Republic of China also have a great impact on foreign trade. Special zones and provinces, which adapted favorable trade policies to attract foreign capital, lost their privileges and they must carry out the same uniform foreign trade policy as other regions throughout China. Another requirement was to enlarge the market entry for foreign products by reducing customs duties and decreasing import tariff levels. (Jiang & Prater, 2002) (Bhattasali, et al., 2004)

The development of the tariff rate from 1990 to the accession of WTO and few years beyond can be seen in Figure 10. The average tariff rate in 1982 was 56% which was reduced to 43% in 1985 and stayed constant at that level until 1992. During the 1990s the average tariff rate declined steadily to 15% by the time of WTO accession. Figure 10 also illustrates the effect of the market liberalization and WTO commitments on foreign trade. (Bhattasali, et al., 2004)

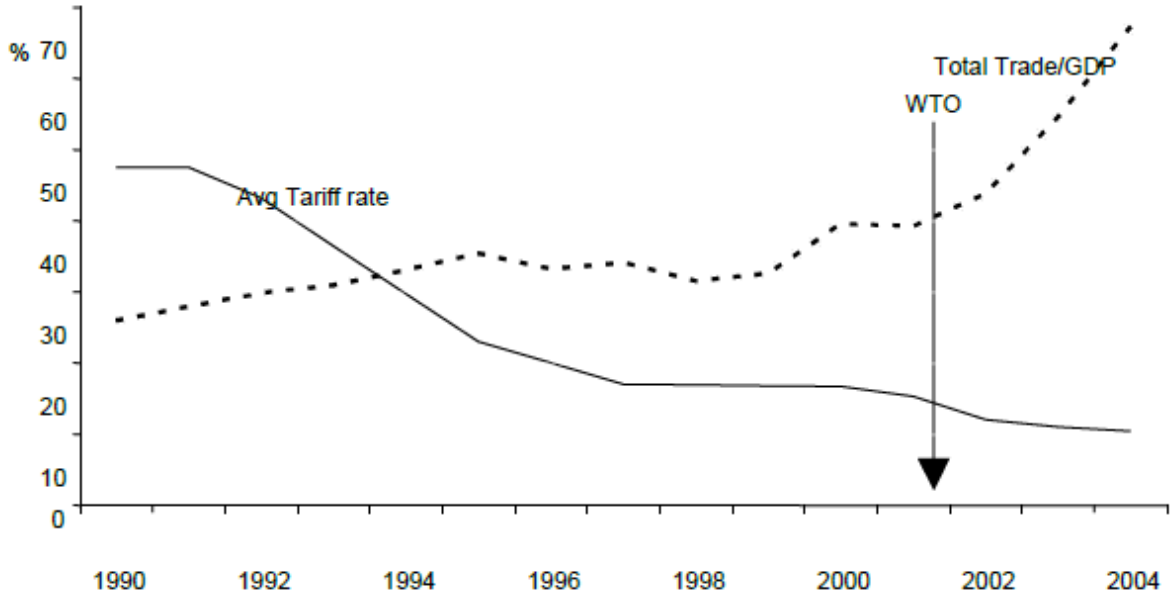


**Figure 10**. China's average tariff rate and trade dependence percent from 1990 to 2004. (Bhattasali, et al., 2004)

### 3.2.2 Logistic Challenges and Development

The first years of the 21st century have been characterized by the fast rapid construction of infrastructure. During the five-year plan of 2001-2005 China made significant investments in infrastructure including the building of 250,000 kilometers of highways and 24,400 kilometers of expressways. The next five year plan of 2006-2010 also invested in the development of roads, ports, railroads and airports. Despite these recent efforts China faces still a lot of challenges regarding logistics. In this chapter we take a look in the common logistic challenges and characteristics presented in recent literature. (Zhang & Figliozzi, 2010)

Despite upgrades in transport infrastructure, China's infrastructure still struggles to satisfy the demand generated by its fast growing economy. Congestions and shipment delays are common at Chinese ports due to capacity shortage. Also highway constructions and transport bottlenecks create congestions problems in port areas. In addition adequate highway networks connecting the more developed coastal regions to underdeveloped inland provinces

increase rail and river congestion, as more companies are moving inland to take advantage of lesser labor costs. (Zhang & Figliozzi, 2010)

Regardless of a reduction in national level regulations since China's entry to the WTO, local governments still set up bureaucratic and political barriers to protect local businesses and prevent the entry of outside competitors. This so called *local protectionism* is driven by the desire to maximize local economic growth, employment, social stability and tax revenues, and less by the concern about efficient use of regional resources or the creation of an integrated national transport network. (Zhang & Figliozzi, 2010)

Railways cannot reduce highway congestions at the present moment. The capacity of Chinese rail systems is insufficient and most of the capacity is used to transport bulk materials such as coal, steel and iron. Trucking has been the dominant transport mode for fright due to its reliability and flexibility compared to Chinese railway service however congestions around port areas due to manufacturers moving inland have forced the Chinese government to plan and invest in the development of railway infrastructure. (Zhang & Figliozzi, 2010)

Approximately 90% of China's international trade volume is handled through maritime transport. Large trade volumes, heavy investments in port infrastructure and intense competition between ports have led to the emergence of highly efficient ports. Although port productivity is not an issue, Chinese ports are affected by inadequate intermodal transport connections, bureaucratic customs procedures, and in some cases low customer service. Hence companies located closer to major ports are significantly less affected by the transportation and logistical challenges and tend to have lower overall logistics costs. (Zhang & Figliozzi, 2010)

In addition interior and mountainous areas still lack modern cable and satellite facilities. Frequent blackouts and power outages hinder logistic development in some areas and many companies lack modern corporate information technology (IT) systems. The absence of web-enabled tools and know-how is affecting Chinese companies' international competitiveness. IT development is regarded as one of the top challenges in China's logistic sector. (Zhang & Figliozzi, 2010)

A study conducted by Zhang and Figliozzi indicate that managers operating in China highlight the importance of good relationships with customs officials and local customs agencies to ensure faster customs clearings and to avoid a high number of inspections. Customs inspections cause not only delays but also increase changes of cargo damage and losses. (Zhang & Figliozzi, 2010)

The World Bank Logistic Performance Index also demonstrates the development in Chinese logistics. Figure 11 displays China's LPI scores for the years 2007, 2010, 2012, and 2014. The diagram is constructed in the same way as Figure 9. Table 8 displays the detailed scores per each category. This table is constructed in the same manner as Table 2.

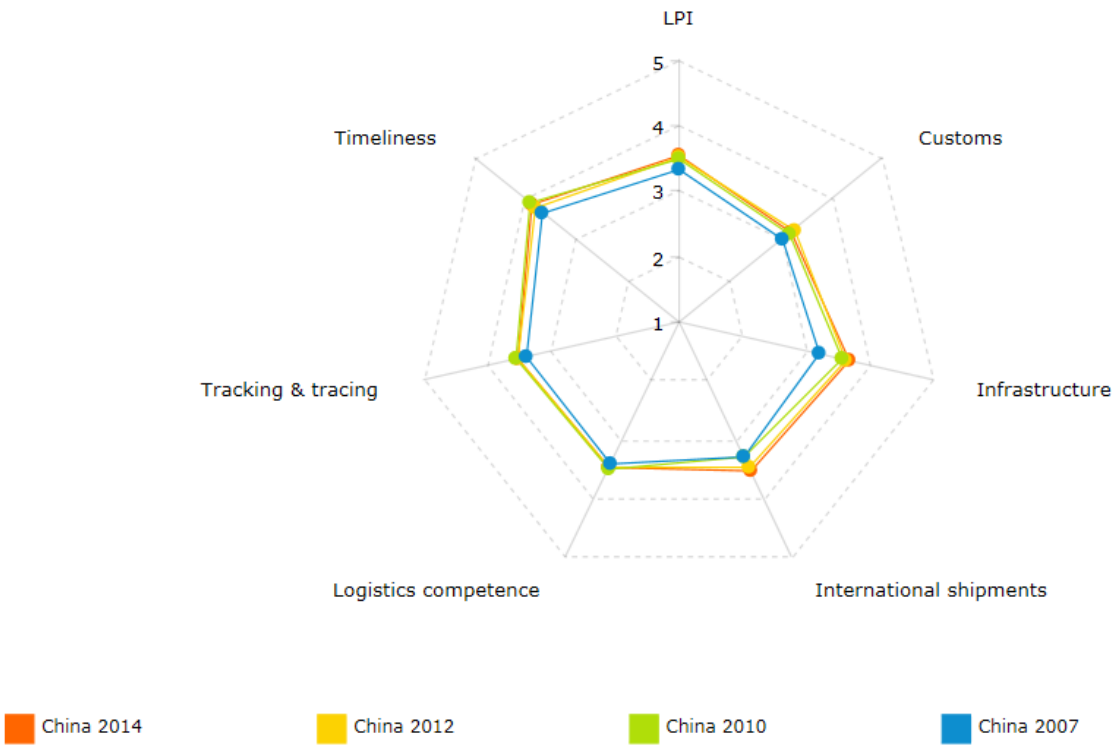


**Figure 11.** Diamond diagram of the logistics performance development of China between the years 2007 and 2014. (The World Bank, 2014)

| Country | Year | LPI Rank | LPI Score | Customs | Infrastructure | International shipments | Logistics competence | Tracking & tracing | Timeliness |
|---|---|---|---|---|---|---|---|---|---|
| China | 2014 | 28 | 3.53 | 3.21 | 3.67 | 3.50 | 3.46 | 3.50 | 3.87 |
| China | 2012 | 26 | 3.52 | 3.25 | 3.61 | 3.46 | 3.47 | 3.52 | 3.80 |
| China | 2010 | 27 | 3.49 | 3.16 | 3.54 | 3.31 | 3.49 | 3.55 | 3.91 |
| China | 2007 | 30 | 3.32 | 2.99 | 3.20 | 3.31 | 3.40 | 3.37 | 3.68 |

**Table 8.** Exact scores of the logistic performance development of China. (The World Bank, 2014)

As seen in Table 8, the overall development has been progressive during the measured time period although the global LPI ranking has been getting slightly worse since 2010. The biggest development has been between the years 2007 and 2010 compared as recent development has been more moderate. The biggest development has been established in infrastructure.

### 3.2.3 Import and Export

The Chinese market has become more open for imported goods and this trend is encouraging for European exporters. Still import to China remains regulated and requires familiarity with procedures, certifications and regulations, a lot of administrative efforts, and patience. In this chapter we provide the main guidelines for foreign trade regarding mechanical and electronic equipment. (EU SME Center, 2012)

To import goods to China you have two basic options: you import them by yourself with your own company or you use a qualified Chinese importer. The Chinese regulations require that the importer has to be a *foreign trade operator*. To become a *foreign trade operator*, a foreign company needs to establish a *Foreign Invested Enterprise* in China. (EU SME Center, 2012)

During the customs clearance procedure, the importer will have to complete the following formalities:

1. Customs registration
2. Customs declaration
3. Document submissions
4. Examination
5. Payment of taxes and other fees
6. Release
7. Foreign exchange control. (EU SME Center, 2012)

Documents required for customs registration are as follows:

1. Business license
2. Registration form
3. Articles of association
4. Registration form of company applying for customs declaration and registration form of managing staff of company applying for customs declaration
5. Organization code certificate
6. Tax registration certificate
7. Bank account
8. Customs declaration special seal
9. Other documents required for the registration. (EU SME Center, 2012)

In the case of mechanical and electric equipment, foreign enterprises need to pay the import duty and the VAT (Value Added Tax) at the rate of 17%. The general tariff rate in China is around the level of 9.5%. The average rate for industrial products is 8.9%. These rates are applied to countries granted the *most favoured nation* (MFN) trading status. MFN countries are required to receive equal treatment, including tariffs and import quotas, as the other partners holding the same status. Members of the WTO agree to accord MFN status to each other. (EU SME Center, 2012)

China also implements the *Interim Import Duty Rate* (IDR) system to further lower the MFN duty rates to encourage importation of certain products such as advanced technological

equipment and key components and parts, energy products, environment-friendly products, and medical products. Generally interim duty rates apply to the industry encouraged for importation by the Chinese Central Government. New IDR are decided case-by-case, but may be as low as 0% or 1%, and are effective for several years, providing customs duty savings for an extended period of time. (PWC, 2013)

Temporary import goods are goods imported to China for a period of time without payment of duty and VAT on the condition that they are re-exported within 6 months. Goods can be imported or exported temporarily using ATA carnet (an international customs document that permits the tax-free and duty-free temporary export and import of goods) or a temporary import and export license. Once the goods have been approved by customs the declarer has to pay a deposit equivalent of the duty customs. In case the temporary goods fail to leave China within six months, the goods have to be formally imported into China according to the customs formalities and duty payments. (EU SME Center, 2012)

### 3.2.4 Logistic Approaches

This chapter introduces logistic approaches to manage spare parts availability in China presented in literature regarding the topic. The approaches are exporting spare parts directly from Europe to the customer or setting up a local warehouse in China.

**Importing & Exporting of Spares**

This logistic approach involves exporting spare parts from Europe to China. The company runs a centralized warehouse in Europe and exports the parts to China and delivers the parts directly to a customer without having local warehouses in Asia. The inventory planning and control are conducted from Europe.

The advantages of this approach are relatively low capital costs as resources regarding inventory planning and control, storage systems, working force and ERP-systems for a local

warehouse are not needed. In addition a centralized warehouse has a high availability of spare parts. (Gebauer, et al., 2011)

On the other hand the logistics costs for delivering spares are higher, especially for short delivery time demanding parts, due to the need of express logistic services. In addition delivery times are prolonged as customs clearance takes their time. Gebauer *et al*. argue that direct exporting of spares is more suitable for more mature Asian markets such as Japan, Republic of Korea, Taiwan, Hong Kong and Singapore. Various disadvantages arise in the Chinese market. Delivery times for exported spares to China take significantly longer even with express shipping services as the part is first delivered from Europe to China in 1-2 days, the customs procedures can take up to five days, and an extra of 1-2 days is added from the domestic delivery to the customer, leading to delivery times of easily over one week. (Gebauer, et al., 2011)

It also has to be taken into account that until 2007 no international logistic service providers were allowed to operate in the Chinese market. Companies had to set up interfaces between international and national logistic operators leading to gaps in communications and trivial challenges such as translations of delivery notes from English into Chinese. (Gebauer, et al., 2011)

Another disadvantage of this approach lies in the repair process of spare parts. Regulations prohibit re-exportations of spare parts from China to other countries. Once a new spare part has been installed, regardless of whether or not the replaced part is repairable, it is prohibited to export the part back to Europe. (Gebauer, et al., 2011)

**Local Warehouse**

Setting up a local warehouse in China is another logistics approach for managing distribution in Asia. The local warehouse is replenished from the central warehouse and delivers spare parts directly to the customer. This approach is complemented by direct export from Europe if the part is not available locally. (Gebauer, et al., 2011)

The main advantage of this approach is that delivery times are significantly lower as the customs clearances are already executed. In addition to shorter delivery times logistics costs are lower. Shorter and simpler deliveries are required for the part to reach the customer from the local warehouse and the replenishment of the local warehouse can be handled with cheaper logistics options than single express deliveries. It is also notable that faster and more predictable delivery times lead to better customer satisfaction in service operations. (Gebauer, et al., 2011)

Disadvantages of this approach are higher operating and working capital costs which have to be taken into account by the company. Inventory and planning create higher operating costs as an ERP-system is required for the local warehouse. International licenses are relatively expensive and users having the skill to operate ERP-systems are harder to find in Asia and require more salary. It is also worth mentioning that not all ERP-systems include Asian characters and if included, it is more expensive and requires the given Asian language to be available in Europe. Otherwise the information needs to be duplicated by the logistics provider or local subsidiary, which leads to higher risk of failures and inconsistencies. (Gebauer, et al., 2011)

Such as the direct export approach Gebauer *et al*. argue that it is easier to implement a local warehouse in more mature Asian markets such as Japan, Republic of Korea, Taiwan, Hong Kong and Singapore. Respectively it is more challenging to implement this strategy in China as more challenges and bottlenecks emerge due to more complicated regulations and bureaucracy. (Gebauer, et al., 2011)

### 3.2.5 Special Economic Zones

For this thesis it is vital to know different possibilities of warehousing in China. Different kinds of special zones and warehouses are treated differently by customs and regulations and can be utilized to improve the logistics flexibility of a regional warehouse in China. This chapter presents different types of warehousing possibilities that can be considered in the logistic planning.

Even though special economic zones are located inside China, they are considered to be outside the customs territory. Therefore these zones enjoy preferential treatment in terms of customs duty and VAT. C.H. Robinson's white paper offers different warehousing options depending on the customs regime available in China. Table 9 displays the warehousing options:

| | |
|---|---|
| **Export Processing Zone (EPZ)** | Industrial park designated by the government to provide tax and other incentives to exporters. |
| **Free Trade Zone (FTZ)** | Special commercial and industrial area in or near ports of entry where foreign and domestic goods may be brought in without being subject to payment of customs duties. |
| **Public Warehouse** | A warehouse subject to government regulation where a number of different companies can store goods. |
| **Bonded Warehouse** | A warehouse where goods are stored under the direct or indirect supervision of a country's import or export authorities. |
| **Bonded Logistics Parks (BLP)** | BLPs consolidate shipments and implement direct import programs acting as a specially designated zone. |

**Table 9.** Warehousing options in China. (C.H. Robinson, 2010)

The first option displayed in Table 9 is the Export Processing Zone. Export Processing Zones are special zones designed for the purpose of processing export goods. No commercial retail, general trade, or other business unrelated to the export processing zone can be conducted within the EPZ. However, research and development, repairing, testing and bonded logistics services are allowed. 70% of goods must be exported in China. (C.H. Robinson, 2010)

A FTZ (Free Trade Zone) is a bonded area where customs exercise supervision and control over goods, transportation vehicles and articles carried by individuals entering or leaving the bonded areas. On 29th of September 2013, China officially launched the China (Shanghai) Pilot Free Trade Zone also known as the Shanghai FTZ. There are 15 free trade zones in China which are all located along China's coast. The Shanghai FTZ is the only zone which allows foreign-only owned trade companies. The zone also does not have a time limit for warehousing goods. (Deloitte, 2014)

A bonded warehouse can be both public and private. Public warehouses are warehouses subject to government regulation where several different companies can store their goods. Private bonded warehouses on the other hand are facilities approved by customs that are privately owned. It is specifically used for storage of goods which are bonded from import taxes and customs clearance and are under the direct or indirect supervision of customs authorities. (C.H. Robinson, 2010) (Deloitte, 2014)

Bonded Logistic Parks are special administrative zones under customs supervision and control that are established in the areas of FTZ or a port near an FTZ for the purpose of developing logistics support between the FTZ and the port districts. (C.H. Robinson, 2010) (Deloitte, 2014)

Bonded warehousing and zones are typically best suited for companies that import goods with the intention of storing or processing them for re-export. It can also provide cash flow advantage on delaying tax payments and imported stocks. (Deloitte, 2014)

### 3.2.6 Political and Legal Risks in China

Although countless market reforms and efforts on increasing transparency have been made since joining the WTO, there are still various business risks in China. China's rank as 96th out of 189 countries in the World Bank Group's *Easiest To Do Business With*-rankings (World Bank Group, 2014) clearly states that the country is still facing a lot of challenges in foreign trade. Risks and challenges arise from various sources such as political, legal and

market behavioral challenges and in this chapter we take a closer look in the common risks in operating in China.

It has to be taken into account that every significant government position is filled with members of the communist party, which has absolute control over legislations and economic and cultural institutions. Despite the government's striving for more transparency with the agreements and protocols through the accession into the WTO, all rules and regulations are not as transparent as in western economies. (Jayaraman, 2009)

Where in western economies strict laws and patents protect domestic and foreign businesses, the legal system in China is more loosely defined, giving rise to various loopholes in the law. China's accession to the WTO has brought the country in the inclusion of international business laws and patent right amendments, but it is still common to see technology and innovation stolen. The Chinese laws can be often interpreted in many ways and wordings may be vague. (Jayaraman, 2009)

China is among the fastest growing economies in the world and the risks of economic stability cannot be excluded. These risks include change of fiscal policy, monetary policy, trade policy and other macro-economic factors. China's economy is mostly dependent on exports from the manufacturing industry. Therefore China has tried to maintain a steady rate of the Yuan against the US Dollar. Hence a big change in the Yuan can reduce the profitability of businesses in China. Also labor costs have steadily increased over the last 10 years and the government has increased the minimum wage level leading to higher operating costs. (Jayaraman, 2009) (Cemat, 2014)

## 3.3 Service Operations in China

Existing literature regarding managing service operations in China and explaining problems such as cultural differences is relatively limited. Establishing profitable service business in China faces a lot of challenges varying from cultural differences to strong competition. The main challenges for establishing a profitable service business in China stems from problems associated with managing the service business in context of the Chinese culture. (Gebauer, 2007)

The aim of this chapter is to build a better understanding of the cultural characteristics and possibilities of managing these differences. As a regional or local warehouse may be established in China, it is vital that the company builds an understanding also of the cultural conditions to improve the chances of a successfully executed project.

### 3.3.1 Cultural Characteristics

It is always difficult to describe cultural characteristics as there is never an absolute truth that can be supported with raw facts and proven evidence. Descriptions are rather based on experiences from various sources subjective opinions. Characteristics develop also from generation to generation and the recent globalization tends to build the markets into a more homogeneous environment. However there is literature trying to explain the fundamentals and common characteristics regarding the business cultural characteristics in China. In this chapter we take a review on the core characteristics and try to build an understanding around the business environment.

Chinese culture is distinguished from the Western culture in various ways, including how business is conducted and business relationships established. One of the main differences is that Chinese prefer to deal with people they know and trust. On a broad scale this may seem similar to the Western culture, but what it really means is that companies have to make themselves known to Chinese companies before any business can take place. This is known as *guanxi* (literally translated to interpersonal relationships or connections) which is

described as the lifeblood of business in China. Guanxi can be roughly translated as personal relationships to secure resources or advantages when doing business. (Jiang & Prater, 2002) (Shou, et al., 2011)

The dynamics of guanxi include *renqing* (favor) and *mianzi* (face). In Chinese culture renqing can be seen from three different perspectives. First of all renqing is associated with emotional responses confronted in daily life. A person who possesses renqing should be equipped with empathy towards the emotions and feelings of the other one doing business with. Second of all renqing refers to a resource that can be presented as a gift in social exchange processes. It is common for Chinese people to offer or render a gift or assistance when their friends have either happy occasions or difficulties. Third, renqing implies to a set of social norms and rules, such as reciprocity and forgiveness, which a person should follow to get along in the Chinese society. These social norms are described as the renqing rule where the goal is to maintain interpersonal harmony. (Shou, et al., 2011)

Another fundamental component of guanxi is mianzi. Mianzi refers to a positive image of a person in a relational context. This can be achieved through proactive impression management or by performing a social role that others recognize. However a person can lose face if they fail to meet the standards of their social role or are unable to deliver the promised help. It is important not to lose face, but it is said to be even more important to "give face" to others (Gebauer, 2007). In conclusion mianzi can be roughly translated as paying respect and recognizing the status of a person in society and it is vital to enhance this status by whatever means possible. (Gebauer, 2007) (Shou, et al., 2011)

Guanxi behavior refers to efforts of developing and maintaining guanxi relationships. Guanxi behavior can be decomposed into "affect investment" and "saving face" (Shou, et al., 2011). Affect investment is more related to an emotional dimension of the relationship where through renqing the target is treated more as a friend. On the other hand saving faces refers to behavior aiming to preserve the other person's face such as avoiding criticizing others in public or satisfying others requests. In addition it includes preserving own face by returning favors. (Shou, et al., 2011)

In Chinese business conducting guanxi behavior may benefit from important favors such as preferential treatment of orders in short supply or prolonged payment deadlines. However it is arguable that guanxi behavior includes costs and risks. Offering favors may lead to concerns about re-payments and developing friendship-like relationships involves costs and risks of abuse. Therefore guanxi behavior requires trust. (Shou, et al., 2011)

To build a long guanxi relationship it is necessary that both parties view each other as trustworthy. If a company always delivers on their promises, they are seen as trustworthy and Chinese companies are more open to work with them again. Being reliable and dependable in every situation strengthens the relationship and improves the possibilities to establish a strong guanxi network in the Chinese business environment. (Jiang & Prater, 2002)

### 3.3.2 Managing Cultural Differences

In context of product-related service for installed base, the Chinese way of a consensus approach to decision making limits the willingness of Chinese management to separate the service from the product business. Service business is also separated by the long-term orientation of Chinese managers. A strong focus is put into establishing binding long relationships with customers where a separate service organization would disrupt the customer relationships leading to two different customer contacts. One approach of managing these challenges is to deploy account managers in the organizational structure to provide product related service. The account managers communicate with the customers and illustrate the benefits of the products and services, which enables the Chinese subsidiaries to establish long-term relationships with the customer. (Gebauer, 2007)

In traditional Chinese business culture, there is a high power distance in the organizational hierarchy system. This restricts the ability of service workers to take responsibility for selling services leading the service manager responsible for the selling and pricing. Compared to common European service unit structures the service manager coordinates the service business and defines the pricing strategy where the product related service is done by several service workers. Studies by Gebauer suggest that Chinese subsidiaries often consist of two

service managers: one to coordinate the daily business and the other to be responsible for product-related sales. These studies suggest that, if the sales manager talks to the customer about product related and customer support services, the customer is more willing to pay an appropriate price for them. (Gebauer, 2007)

Studies by Gebauer indicate that Chinese service managers are also highly risk-averse in context of pricing the availability of their machinery and equipment. In a pricing mechanism, where the pricing of equipment availability is related to estimating the operating risk and demand, profitability depends on how accurate the estimations of product failure risks are. Service contracts regarding the availability of certain parts can be established between the service provider and the customer but Gebauer's studies suggest that Chinese service managers are very reluctant to define specifications and enforce strict contracts between customers. Building relationships between the customers are favored over establishing rigid contractual agreements and pricing and specifications are rather based on personal relationships. (Gebauer, 2007)

### 3.3.3 China-Japan

For this thesis it is relevant to understand the relations of China and the nearby countries in Pacific Asia as one of the aims is to evaluate how a possible local storage in China could support the region and vice versa. In understanding the dynamics of the region one of the most important relation is the one between China and Japan, which both also contain the most installed base volume wise in the Pacific Asia region.

The China-Japan relationship is one of the most important bilateral relationships in terms of impact on economic welfare, security and peace in the Pacific Asia region and the world more broadly (Armstrong, 2012). The economic relationship between the two countries has seen large growth in recent decades. Starting from very low in the late 1970s by 2007 trade between China and Japan was the world's third largest trade relationship of merchandise in terms of exports and imports together, only behind the United States-Canada and United States-China trade relationships. (Armstrong, 2012)

In recent years the economic engagement has been important from Japan's perspective for the recovery from the economic downturn of the 1990s, as China has been a major factor in Japan's externally driven growth. From China's perspective the relationship has been important in terms of "catching up" in the field of modern industrial technology and its transition from a low to a higher income economy. The China-Japan relationship also has a major impact on the rest of the region because of the large production networks in which both countries are involved. (Armstrong, 2012)

Mutual antipathy is still present between the two nations. For many Chinese, Japan's history of military aggression against China is a persistent theme that emerges repeatedly. Even still, in the year 2006 a poll conducted in China, 71 per cent of Chinese people surveyed responded that Japan was not "a force of good". Also anti-Chinese sentiment has grown in Japan especially after the Tiananmen Square massacre in 1989. Anti-Chinese sentiment is also growing as a result of social issues such as illegal Chinese immigrants and concerns about tainted food imported from China. (Smith, 2009)

Growing trade between the countries has occurred despite the political tensions and historical issues. Studies by Smith indicate that the economic relationship between China and Japan are not diminished or disturbed largely by political tensions to any significant extent. (Smith, 2009)

# 4 Volume of Installed Base

## 4.1 Installed Base Allocated to Local Offices

For this thesis, it is relevant to take a look at the installed base in the examined region. As the installed base consists of moving naval vessels, it is not possible to define fixed locations for the installed base. Therefore to determine the installed base in the region we have to first take a look at the different subsidiaries working in the area, hence the country's ABB Marine offices are responsible for the fleet indicated to them, meaning that spare parts are sold to these vessels through their indicated country office. Table 10 displays the vessels allocated to the office in China:

| Owner | Vessel | Delivery | Pod type | No. Of pods |
|---|---|---|---|---|
| China Coast Guard | Zhong Guo Hai Jing 3383 | 2005 | CO0980L | 2 |
| Sinorail Bohai Train Ferry | Zhong Tie Bo Hai 1 Hao | 2006 | CO1400L | 2 |
| Sinorail Bohai Train Ferry | Zhong Tie Bo Hai 2 Hao | 2006 | CO1400L | 2 |
| Sinorail Bohai Train Ferry | Zhong Tie Bo Hai 3 Hao | 2008 | CO1400L | 2 |
| China Oceanalogy Academic Sciences | Kexue | 2012 | CO0980L | 2 |
| Sinorail Bohai Train Ferry | Spare Azipod | 2012 | CO1400L | 1 |
| China Coast Guard | Zhong Guo Hai Jing 2305 | 2014 | CO0980L | 2 |
| China Coast Guard | Zhong Guo Hai Jing 2306 | 2014 | CO0980L | 2 |
| China Coast Guard | Zhong Guo Hai Jing 2307 | 2014 | CO0980L | 2 |
| China Coast Guard | N/A | 2014 | CO0980L | 2 |
| China Coast Guard | N/A | 2014 | CO0980L | 2 |
| China Coast Guard | Zhong Guo Hai Jing 3306 | 2014 | CO0980L | 2 |
| China Coast Guard | Zhong Guo Hai Jing 1306 | 2014 | CO0980L | 2 |
| China Coast Guard | Zhong Guo Hai Jing 3307 | 2014 | CO0980L | 2 |
| China Coast Guard | Zhong Guo Hai Jing 1307 | 2014 | CO0980L | 2 |
| China Coast Guard | Zhong Guo Hai Jing 3308 | 2015 | CO0980L | 2 |
| | Spare Pod | 2014 | CO0980L | 1 |
| China Coast Guard | N/A | 2015 | CO1250L | 2 |
| China 3rd Institute of Oceanography | N/A | 2016 | CO0980L | 2 |
| China 1st Institute of Oceanography | N/A | 2016 | CO0980L | 2 |
| Guangzhou Salvage Bureau | | 2015 | CO1400L | 3 |
| China Coast Guard | Zhong Guo Hai Jian 50 | 2012 | CO0980L | 2 |
| ZPMC Shipping | ZPMC | 2010 | CZ1400S | 4 |
| | | | **Total** | **47** |

**Table 10**. Vessels allocated to the local Chinese office.

As seen in Table 10, with the current estimates there will be a total of 47 Azipods allocated to the Chinese office by the year 2016. These vessels operate mainly in Chinese waters and can be reached through ports in China. The installed base is also relatively homogeneous.

The majority of these Azipods are CO0980L types, which represent 31 Azipods of the fleet. The second most represented type is the CO1400L type, which account for 10 Azipods. In addition there are four CZ1400S and two CO1250L Azipods. It is notable that the entire fleet consists of C-type Azipods. These C-types vary in size and power, but the overall construction follows the same principles. However as the size of the Azipod varies, many critical parts such as bearings differ also in size.

It is also notable that the installed base in China has risen exponentially in recent years as seen in Figure 12. In 2010 there were only twelve Azipods, where as in 2014 there are already 36 Azipods. As the installed base affects the spare part business after the delivery the increasing amount will be felt in the spare parts business in the coming years.

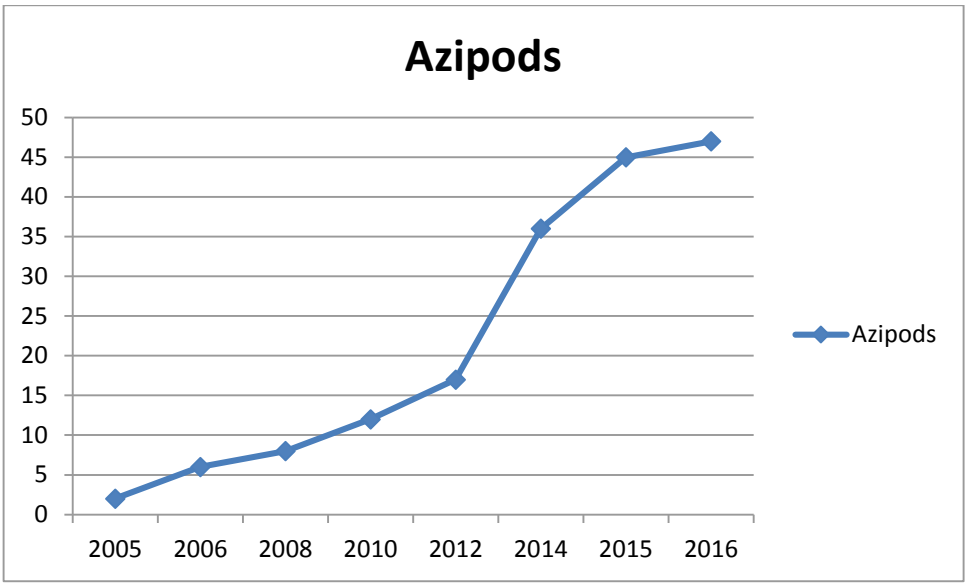


**Figure 12**. Development of the installed base in China.

Another notable fact is that 24 Azipods of this installed base are owned by the same party, the Chinese Coast Guard. This enables possibilities for service contracts and building long term business relationships, whose importance was highlighted in literature describing Chinese business characteristics.

Table 11 displays the vessels, whose spare parts are sold through the Japanese office. The installed base in Japan contains four Azipods that are divided into two types: VC2100 and XC2100. There are two Azipods per type.

| Owner | Vessel | Delivery | Pod type | No. Of pods |
|---|---|---|---|---|
| Shin-Nihonkai | Hamanasu | 2004 | VC2100 | 1 |
| Shin-Nihonkai | Akashia | 2004 | VC2100 | 1 |
| Shin-Nihonkai | Suzuran | 2012 | XC2100 | 1 |
| Shin-Nihonkai | Suisen | 2012 | XC2100 | 1 |
| | | | **Total** | **4** |

**Table 11**. Vessels allocated to the office in Japan.

Table 12 represents the installed base allocated to the Korean office. As seen from the table the Korean office has only one vessel with two CO1400L type Azipods. This type is the second most common type present in the Chinese installed base.

| Owner | Vessel | Delivery | Pod type | No. Of pods |
|---|---|---|---|---|
| STX | Sun Rise (ex-STX Rose II) | 2012 | CO1400L | 2 |
| | | | **Total** | **2** |

**Table 12**. Vessel allocated to the office in the Republic of Korea.

Figure 13 represents the variety of the Azipod types in the defined region. As seen in the figure, the majority are C-type pods. The most common individual type is the CO0980L type which accounts for 31 of the installed base. The second most common type is the CO1400L type which represents twelve Azipods of the installed base.

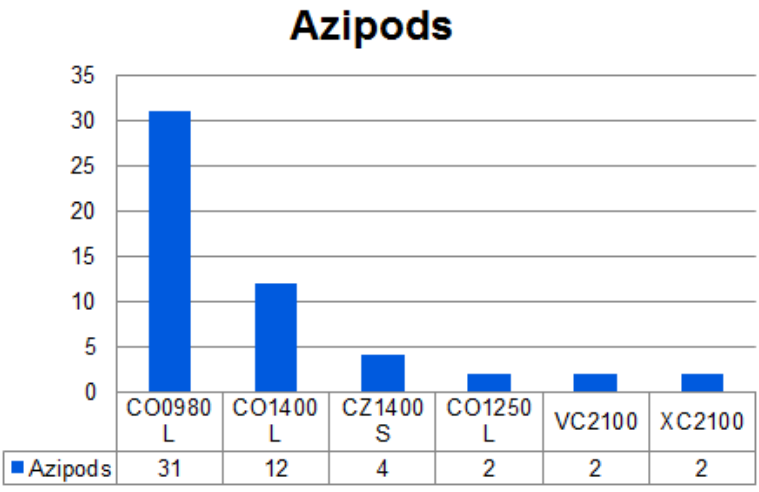


**Figure 13.** Variety of Azipod types in the Pacific Asia region.

## 4.2 Other Vessels Operating in the Region

In addition to the vessels allocated to the region's local ABB offices, foreign cruise ships also operate in the area. These cruise ships use various ports in the Pacific Asia region in countries such as China, Australia, Singapore, Japan, Republic of Korea, and Hong Kong. Vessels operating in the area can be seen in Table 13. This information is based on going through the cruise schedules for the upcoming season 2014-2015.

| Owner | Vessel | Delivery | Pod type | No. Of pods |
|---|---|---|---|---|
| Royal Caribbean | Explorer of the Seas | 2000 | VO2100 | 2+F |
| Royal Caribbean | Mariner of the Seas | 2003 | VO2100 | 2+F |
| Royal Caribbean | Voyager of the Seas | 1999 | VO2100 | 2+F |
| Royal Caribbean | Quantum of the Seas | 2014 | XO2300 | 2 |
| Costa Crociere | Costa Luminosa | 2009 | VO2100 | 2 |
| | | | **Total** | **13** |

**Table 13**. Cruise vessels operating in the Pacific Asia region in the next 12 months (season 2014/2015).

As displayed in Table 13, there are various vessels with Azipods operating in the area. For the season 2014/2015 there is estimated to be 6 vessels with a total of 13 Azipods. The F in the number of pods column represents fixed Azipods which do not contain a slewing system, meaning that they are unable to turn. These cruise ships contain mainly larger open water Azipods, 13 VO2100 types and two XO2300 types. Figure Q displays an example of a cruise vessel's route.

The cruise vessel's route in Figure 14 is the route of Quantum of the Seas and it is an example of cruise route possibilities. On this cruise the vessel travels from Shanghai to Fukuoka, Japan, from where it heads to Busan in the Korean Republic. The final destination is back in China at the port of Tianjin.

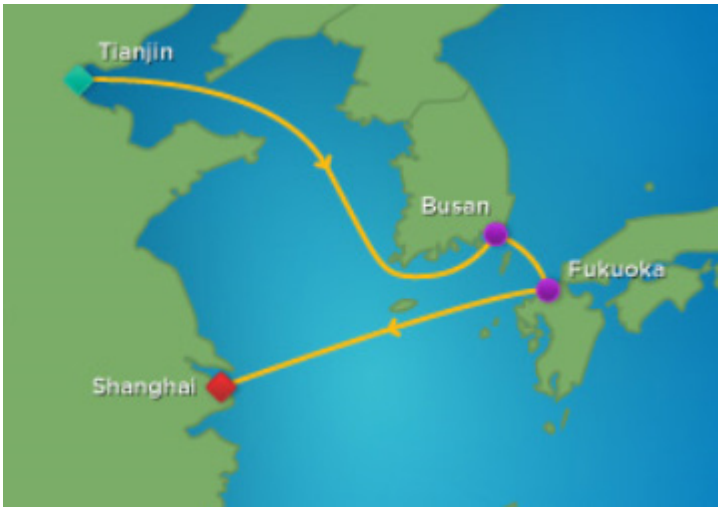


**Figure 14**. Route of the cruise vessel Quantum of the Seas. (Royal Caribbean, 2014)

In addition do to developments in the Russian gas exporting business LNG vessels are operating in the Pacific Asia area. Russian LNG vessels transport gas to Japan and arrive north from Russian waters to the coast of Japan. These vessels are allocated primarily to the Russian ABB, but in case of critical failures in Pacific Asian waters availability of spares in the nearby region has to be taken into consideration.

# 5 Availability Planning in Pacific Asia

In this chapter we consider different logistic approaches to improve the availability of spare parts in China and the nearby region. We evaluate first the options of having a centralized warehouse in China and divide this further into two options: using and enhancing current facilities or setting up a logistic center from scratch by renting a warehouse. Additionally we compare locating a warehouse in other countries of the region defined in this thesis.

To understand the evaluation we need to first take a look how the availability of spare parts is built currently at ABB Marine. The availability is planned either two or three phased depending on the destination of the customer. In the two phased model local offices sell spare parts either provided through the main storage in Turku, Finland or in some cases purchased locally. Additionally customers hold recommended critical parts on board of the vessels hence the model is described as two phased, as parts are provided either through the main storage or the on-board stock. In the three phased model Turku serves as the main storage, another warehouse is located in the region serving as buffer warehouse, and the customer holds again critical parts on board. In this chapter we focus on establishing a three-phased model in Asia where a regional warehouse would be set up in the defined region.

We evaluate the possibilities by taking into account characteristics of the spare part business provided in the literature review and compare country specific statistics provided in chapter 3. Issues and development points are addressed through conducted interviews and workshops with either ABB personnel working currently in China or personnel who have experience working in the defined region. In addition a Valmet employee working in Wuxi China was interviewed to broaden the view on European based multi-global companies operating in China, especially in the service field.

## 5.1 Logistic Center in China

In chapter 5.1 we consider the possibility of establishing a regional warehouse in China to serve the entire Pacific Asia region with spare parts. First we highlight the market conditions to be taken into consideration and consider either enhancing the current facilities or establishing a new warehouse from scratch.

One of the challenges needed to be addressed are the delivery times. If a part is needed urgently, the availability has to be built in a way that it will reach the vessel as soon as possible. If a part is needed on a non-Chinese vessel it does not help that the part is located geographically close if the part is delayed by Chinese customs for several days anyway. This needs to be addressed also vice versa: if a Chinese vessel needs parts, it also has to be able to reach the vessel urgently without unnecessary delays.

In addition the costs have to be taken into consideration. China's tariff rates average around 8.9% and operation costs will increase if parts are first shipped to China and from there exported further to another country with high tariffs.

### 5.1.1 Conditions

Regarding quality of suppliers, local vendors tend to produce quality standard products as smaller suppliers see having global companies as a huge advantage. There may arise some issues at the beginning of the supplier relationship but with cooperation these are easily manageable. Bigger suppliers, global companies, produce the same quality they produce all over the world as quality controls are similar globally. The myth of domestic manufactured poor quality products is seen as long gone by interviewed professionals and the problems they face in China with suppliers are comparable to the ones they are facing in western countries also. By building long term relationships, demanding high quality, and cooperating with the supplier local purchasing does not cause significant issues. (Korhonen, 2014) (Fan, 2014) (Laakkonen, 2014)

However the domestic logistics still need a lot of development. Transport regulations are often neglected and the lack of following transporting instructions of products can lead to damage of goods. Additionally safety instructions are often ignored. Even by using international logistic providers the same issues arise as foreign logistic companies are relatively new in China and their network is based on local operators. A product can be transported very fast if urgently needed but the risk of damaging the product or risking safety can be high. (Laakkonen, 2014) (Korhonen, 2014) (Fan, 2014)

It is also addressed that local help and work force is necessary for foreign companies. In China negotiations play an important role in making business. The culture tends to be that asking prices are extremely high, but are lowered by building relationships and negotiating. It is also common that negotiations are not conducted in meeting rooms and office areas, but rather at dinners at restaurants and other leisure venues. The Chinese also prefer to hold business talks in Chinese where the help of locals is a must as they not only know the language but the proper phrases and ways of stating themselves with business partners. However the presence of foreign employees is also regarded as important as it sends a credible image of a global company. (Korhonen, 2014) (Fan, 2014)

The culture of mianzi (loosing face) is still seen as being present. Local employees are often exposed as hiding mistakes and rather not confronting others by admitting something has gone wrong. However workers are skilled and motivated to learn, they just tend to need time to get used to a foreign company's working culture. (Korhonen, 2014) (Fan, 2014) (Laakkonen, 2014)

As written in chapter 3 and confirmed by the interviews, Chinese customers still value long term business relationships highly. Trust is built through active interaction and cooperation with the customer. Customers are willing to buy spare parts that are more expensive than domestically manufactured from long term business partners as they trust they will receive more service and support through constant interaction. (Fan, 2014)

### 5.1.2 Current Facilities

Currently the local Chinese service office has rented warehousing space from the ABB production facility in Shanghai. The rented space is dived into two parts: One space in the warehouse part of the facility and the other space inside the production hall. In total the warehousing area for service is 172 $m^2$.

The space in the warehouse area is 140 $m^2$ and has shelf space on one wall. This space is currently used for a spare pod. The area is however located right next to the warehouse entry, which is a large sliding door. This has the effect that the temperature in the service warehouse area is strongly dependable of the outside temperature. The door is held often open as there is also outside warehousing space for the production facility which is used frequently. This means that the area gets in the winter time close to the outside temperature going near 0 degrees Celsius, however the space is getting also some warmth from the inside heating. During summer time the area is extremely warm as the temperature in Shanghai frequently exceeds 30 degrees. The large sliding door at the warehouse entry is also exposing the area to air flows affecting the area.

The space rented inside the production hall is located in the central area of the hall and has a surface area of 32 $m^2$. This area is relatively small, but can be used efficiently for example for small refurbishment tasks. The area is not affected by outside conditions and has also the benefit that it is surrounded by the production facilities hence tools can be easily borrowed if needed. Heavy items up to 35 tons can be lifted in the area with a production hall crane.

The space is currently used mainly for spare pods and some individual parts. It is operated by ABB China's Service, but cannot be classified as an efficient spare parts warehouse. The facility is operated by individuals and there is no material management system or ERP controlling any inventory levels or material movement. The warehouse however serves as a small buffer for the current volumes of installed base in China and the overhauling area is also used for small refurbishments. The production factory itself holds a buffer for propeller bearings which could be used in cooperation with Service. The factory also holds some consumables such as cables.

### Location

Location wise the factory is not located in the same area as the service personnel. However, the factory is in an ideal location to serve Asian and global shipbuilding markets, as it is on the outskirts of Shanghai near the shore and very close to the Donghai Bridge. The bridge connects the Port of Shanghai and the Yangshan Deep-Water Port, which is a port for container ships in Hangzhou Bay. A connection with two major ports is a huge advantage as operating vessels can be reached easily. As stated in chapter 3, the literature regarding Chinese logistic challenges states that although Chinese ports have developed into being highly efficient, the biggest challenges are the connections to the ports.

### Advantages and Needs

| Advantages | Needs |
|---|---|
| Geographical location | Location of storage space inside the facility |
| Overhauling facility | Lack of ERP or material management systems |
| Production expertise nearby | Storage space as installed base expands |
| Availability of tools | |

**Table 14**. Competitive advantages and needs of development.

Table 14 displays the basic competitive advantages and needs of development of current facilities. The advantages are an optimal location to serve the regions market, the overhauling area, having professional know-how about products at constant reach through production personnel, and the possibility of loaning easily production tools for overhaul. The needs of development are: the location inside the factory near the sliding door and being exposed to temperature and humidity changes, lack of proper ERP or material management system, and the amount of storage space as installed base grows.

The production factory has recently bought new storage space nearby the factory, which could be seen as a possibility for enhancing the service storage. However the downside is

that as the production factory expands their needs are taken into account first, after which wishes from the service side are being heard. This narrows the possibilities of fulfilling all the requirements for an efficient spare part warehouse.

**Serving as a Regional Warehouse for the Pacific Asia Region**

Even though the facility is located in an ideal position, near to the Port of Shanghai and the Donghai Bridge, and considering the amount of installed base in China, the storage space is insufficient. The location inside the factory cannot serve as a proper regional warehouse if more expensive parts would be stored at the facility. The risk of outside factors like weather conditions affecting the parts is too high.

If the storage space would be moved inside the factory, there is only limited storage space the production facility can offer. As China's installed base is expanding exponentially the space will be insufficient even only for the Chinese installed base.

In addition it has to be taken into account that the availability of spare parts and maintenance is also a selling point for new-building projects and service contracts. If we imagine the scenario that a client wishes to see how this aspect is taken care of, the current facilities added with the fact that the storage is not operated with any material management IT-systems, it does not give an impression of an efficient and reliable regional warehouse or logistic center.

In principle the current facilities might have potential serving as a logistic facility, however the fundamentals of an efficient regional warehouse serving the entire Pacific Asia region are severely lacking. If the facility had to provide for the entire region, and the installed base in China keeps expanding the current storage base is clearly insufficient.

### 5.1.3 Warehouse Rental and Possibilities in China

**Warehouse Rental**

As Chinese laws prevent mostly foreign owned companies owning properties, the common procedure is renting a warehouse or warehousing space. Renting is made simple with competitive prices as local areas and provinces promote their region to earn more tax revenues through established global companies setting up shop in the area. Chinese developers build so called standard factories that can be obtained with a fast schedule. These standard factories serve as facilities for new industrial companies entering the region and contain all the basic needs for an industrial factory. These factories include a warehousing area with standard lifting equipment and storage facilities which can be further developed. A standard factory with a larger warehousing area could serve as a regional warehouse as the remaining space could be used for overhauling.

In addition China offers a large amount of similar standard warehouses and warehousing space for leasing. Property leasing webpages offer a large variety of different warehousing options, with maximum loading weights, clearing heights and lifting gear possibilities depending on the needs of the customer. Warehouses are often offered in specific areas designed to serve as logistic regions which are located near airports or ports. It is notable though that most warehouses are not offered with a starting price and the majority of the rental ads indicate the price as negotiable. This highlights the importance of having local knowledge and good relationships in the area.

New work force can be recruited with the help of ABB China. All the required bureaucracy for the process can be dealt with the local HR. Also finding suitable work force is not seen as an issue as established multi-global companies like ABB are seen as lucrative employers. [Korhonen]

**Special Economic Zones**

To compare locating the warehouse in a special economic zone like a free trade zone or a bonded warehouse with non-bonded solutions we create a table, Table 15, with the main differences of the options and how they affect different scenarios that may occur in the spare parts business. It has to be noted that regulations in detail can vary between FTZs

| | Free Trade Zones/Bonded systems | Non-Bonded solution |
|---|---|---|
| **Formalities:** | | |
| **Company registration** | Foreign owned companies and joined ventures allowed in Free Trade Zones. Bonded warehouse could be owned by ABB Finland | More restrictions for foreign investors. Warehouse would have to be owned by ABB China |
| **Customs administration** | Goods leaving for foreign countries are free from duties, quotas or import/ export permits. | For goods imported into China go through customs clearance; and vice versa, the export customs clearance shall be proceeded. Bonded systems are carried out for state approved bonded warehouses outside special zones. |
| **Scenarios:** | | |
| **A part is needed urgently for Chinese customers** | Part has to go through Chinese customs clearance and shipment will be prolonged. | Part can be directly sent to the vessel. |
| **A part is needed urgently for a customer outside China** | Part can be sent immediately. Shipment may be delayed depending on the receiving party's country specific customs procedures. | Part has to be exported through Chinese customs clearances. |

**Table 15**. Main differences between bonded and non-bonded zones.

As seen in Table 15 the special economic zones give more freedom regarding ownership of the facility as the regulations for foreign owned companies are strictly regulated in China. It also provides the opportunity to export imported goods out of China without going through customs clearance. However if parts are consumed in China, goods have to go through customs clearance.

Regarding shipments it is dependent where the goods are being sent. If goods are needed inside China urgently, the non-bonded solutions are faster as customs are avoided. If something is needed outside of China, the bonded solution is faster. In the scenario where goods are needed outside of China and goods are stored in a non-bonded warehouse, the difference of the parts being sent straight from Finland to the desired location and parts being sent from China does not differ that much as the biggest time waste in the shipment arises from the customs and flights straight to Asia from Finland fly daily. If goods are needed inside China and they are stored in a bonded area the gained advantage of having the part in China is only the saved time in not having to fly the part from Finland as the biggest delay arises again from the customs clearance in China.

### 5.1.4 Warehouse Solution Model

The Shanghai Free Trade Zone provides the opportunity to set up foreign owned or joined ventures inside the zone and offers also the possibility to have a combination of a bonded and a non-bonded storage. We propose a solution model of this hybrid type warehouse where a warehouse is rented inside the free trade zone, and which would be owned partially by the Finnish ABB and partially by the Chinese ABB. The storage space would be a combination of a bonded area and a non-bonded area. The fundamentals are presented in Table 16.

**Ownership and Control**

| | |
|---|---|
| **Ownership** | Joint venture between ABB Finland and ABB China or Third-party |
| **Control** | ABB China controls the non-bonded area. ABB Finland the bonded area. |
| **Storage** | Contains a customs supervised bonded area and a non-bonded area |

**Table 16**. Fundamentals of the warehouse solution.

The idea of this model is to create a joint venture between ABB Finland and ABB China where the control and ownership of the parts would be clearly regulated: ABB Finland would be controlling and owning the parts in the bonded area and ABB China the parts in the non-bonded area. This would mean that ABB China would be in charge of parts meant preliminary for Chinese customers and Finland for the parts that are preliminary meant for re-export.

Parts that are meant for re-export can be imported and exported without customs clearance and duties. The FTZ in Shanghai does not require the part to be processed further and it can be re-exported in the same state as it was imported without customs duties. Parts imported to the non-bonded area can be consumed in China without further customs clearances.

However the ABB regulations on owning facilities in other countries may create contradiction. If the only possibility is that the warehouse and its belongings are ABB China owned the bonded area could be arranged via consignment solutions or the warehouse could be outsourced to a third-party. In the third party solution ABB China would pay for the service of the non-bonded area and ABB Finland for the service in the bonded area leading to same divisions of responsibilities as in the joint venture.

**Functioning Principle**

The basic principle of this model can be seen in Figure 15. The arrows represent the goods movement. Filled arrows represent movement where goods go through customs clearance and tariffs have to be paid. The blank filled arrows represent movement which can be executed without customs clearance and duties.

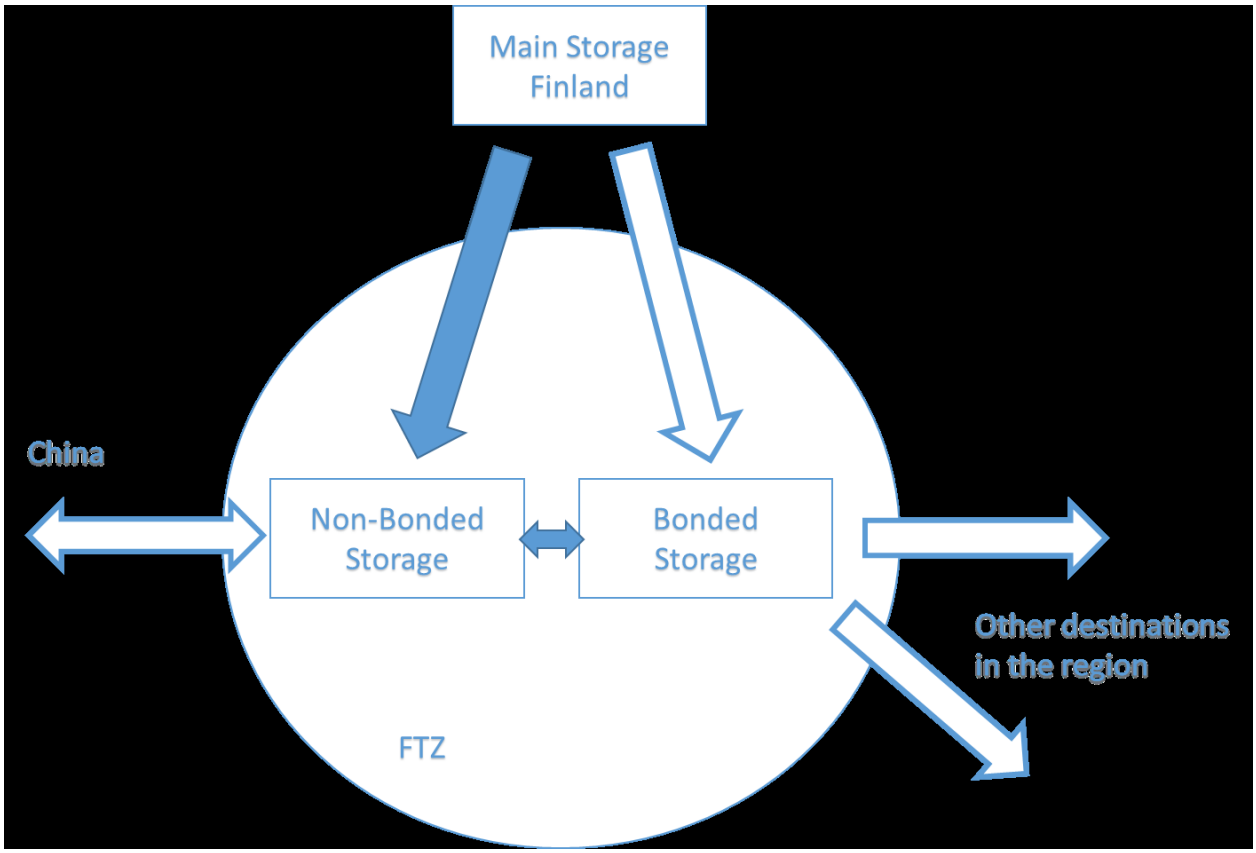


**Figure 15**. Functioning principle of the warehouse model

As seen in Figure 15, goods moved to the warehouse from Finland or other parts of Europe can be performed in two ways. Parts planned to serve the rest of the region are delivered to the bonded area and can be exported further to the final destination without customs clearances. If parts are planned to serve the Chinese market they are imported to the non-bonded area through customs clearance.

As the parts for the Chinese market are already imported they can serve the Chinese customers immediately when needed without customs clearances. Parts sourced locally can also be stored in the non-bonded area. Locally sourced parts can be brought to the non-

bonded storage but if these are further exported or moved to the bonded storage, are they exposed to customs clearances and duties.

Parts can be moved between the bonded and non-bonded areas but customs clearance has to be performed between these storages. However if a part is needed for the other market urgently smaller movements can be performed as so called sample shipments, which can get faster through customs in individual cases. Also co-operation with customs officials can benefit in getting the parts faster through clearance.

**Separation of Parts**

The separation of the parts to be stored at the proposed warehouse is relatively simple and understandable by taking a look at the presented installed base volumes in chapter 4. China's installed base contains only C-type Azipods in contrast to the allocated Azipods for the rest of the region. Additionally the cruise vessels operating in the area are mainly V- or X-types. Only the Republic of Korea has an Azipod allocated to their office which has C-type Azipods, but it is only one vessel with two pods.

This distribution of the installed base in the region means that only critical parts and wanted consumables for C-type pods would be imported directly into the non-bonded area for Chinese ownership and parts for larger pods would be stored in the bonded area. By owning the parts for Chinese customers directly, ABB China would also have more freedom in building availability agreements with customers.

Cost savings can also be made by the first filling of the warehouse. Parts imported to China, which cannot be sourced locally and which are to be stored in the non-bonded area, must go through customs clearance and duties and tariffs have to be paid. However ABB can apply for the interim duty rate, as described in chapter 3.2.1, and reduce the duty rate of parts to close to 0% for a temporary time. As the interim duty rate is approved by the government and is granted mainly for technology encouraged by the government, it is in ABB's case well-reasoned as most of the installed base in China is government owned.

The inventory can be planned in Finland through the categorization of spares as presented in chapter 2.2. The main storage would be still located in Finland where spares, whose failure in installed base can tolerate a short time period without the part, are stored. The regional warehouse should contain critical parts where failures may lead to system downtimes and other risks. In addition the regional warehouse can contain basic consumables whose demand is easier to predict and consumptions cycles are faster.

**Location**

The Shanghai FTZ is chosen because it is the only zone in the country where joint ventures with foreign companies are allowed. Another important aspect is that there is no time limit for the storage of goods in the Shanghai FTZ. As explained in chapter 2.3, spare part inventories exist mainly to keep equipment in installed base in operating condition leading to high inventory stock levels. It may therefore lead to cases where parts are stored for long time periods as no breakdown of these parts occurs. The demand pattern is extremely difficult to forecast and a time limit on storage time could cause challenges and additional work and waste of resources as parts would have to be moved even though they are not consumed.

More specific we choose the Waigaoqiao FTZ that is part of the Shaghai FTZ. The proposed area is located right next to the Waigaoqiao Container Port (second highest orange dot in Figure 16) and is 20 kilometers from the Pudong International Airport and 28.8 kilometers from the Hongqiao Airport. The zone has one of the lowest corporate import taxes at the rate of 15%. Rents in the FTZ are around 1.13 RMB (0.18 US Dollars) per square meter a day.


**Figure 16.** Location of the FTZ in Shanghai.

The FTZ is located also geographically in an excellent position. It has great connections for the domestic market, but also considering the Asian market with Tokyo, Hong Kong, and the Republic of Korea locating within an 1800 kilometer radius. The close-by airports serve all, and the fast access to the Donghai Bridge enables transport to other parts of China.

**Benefits**

The advantage of this model is that parts are not owned only by the Chinese ABB but also by ABB Finland hence parts could also be seen in the Finnish material management systems. Thereby operations can be better controlled and planned. Transactions and shipments with non-Chinese customers can also be executed directly between Finland and the other countries in the region needing the parts and China does not have to serve as a middle man leading to

lowering the risk of communication problems and misunderstandings. In the consignment solution the parts would also be owned by ABB Finland and could be controlled with Finnish material management systems.

If foreign ownership is restricted in company regulations the third-party solution would lead to similar benefits as in the joint venture as the management and control of the different storage sides is clearly defined. The third party solution would also opt to easier cost control as there is a fixed price for the service and local knowledge could be utilized trough the service provider.

The benefits of the separation of storage areas would be enormous in terms of shipment times and it would also save money as unnecessary tariffs and customs duties are avoided. By having the parts for Chinese customers in the non-bonded area, the customs clearance has already been executed and parts can be shipped directly to the customer without waiting for clearance. The parts for the rest of the region can also be sent directly to the desired destination as they do not have to go through Chinese customs clearance when leaving the bonded area and time is saved up to several days compared to having these parts in a non-bonded warehouse in China.

ABB China can also still purchase parts locally as they can be transported and stored in the non-bonded area. They can continue using their vendor network as they used to, since they will own the parts for Chinese customers.

Logistic costs are also saved compared to having only a main storage in Finland. By proper planning parts for filling the warehouse can be shipped via sea freight and other cheaper options compared to express shipments directly to customers. Urgent shipments are also lower as vessels are operating closer compared to shipping parts from Finland.

Customs supervised warehouses are strictly controlled by officials especially if a company has combination of both bonded and non-bonded warehouses as proposed in this model. This also has indirect effect as the area is strictly controlled the storage is kept safe from outside intruders as the movement in the zones is constantly controlled.

As presented in chapter 3.2.4 re-exportation of used spare parts from China is prohibited, thus it is fundamental to maintain a non-bonded area. If spare parts need to be refurbished and the spare parts facilities are desired to be used for it, a non-bonded area is required as refurbishments made in an only-bonded warehouse would require the exporting of the part.

**Challenges**

One of the biggest challenges of the proposed model is the entire establishing process. The system requires detailed planning and strict control among the entire supply chain. Bureaucratic procedures tend to be extremely difficult in China and require the knowledge of local practices. It also has to be taken into account if ABB China is creating a joint venture in a FTZ that nothing contradicts with any of their current licenses regarding trading.

In case the warehouse would be outsourced to a third party due to contradiction in owning facilities abroad, it would complicate but not prevent the suggested model as described previously. The outsourcing leads though to risks as the operations would be dependable on the quality and skill of the service provider.

## 5.2 Comparison of Other Countries in the Region

In this chapter we compare the possibility of locating a regional warehouse in another country in the region. We compare having the logistic center in one of the countries with ABB Marine offices: Japan, Republic of Korea, or Singapore. In addition we add Hong Kong as it is one of the leading financial centers in East Asia and also due to its close bound with China.

To compare the countries we choose relevant indicators to global spare parts logistic. These key indicators are customs efficiency, logistics and investment costs, and overall logistic performance. Additionally we evaluate these results and offer an alternative location for the regional warehouse.

### Customs Efficiency

Customs efficiency is defined in this thesis as one of the key indicators as we have to consider the possibility that a part is needed urgently and the shipment will be prolonged significantly by customs. In Figure 17 we compare the customs clearance times in days, with data from the World Bank LPI presented in chapter 3.1.2:

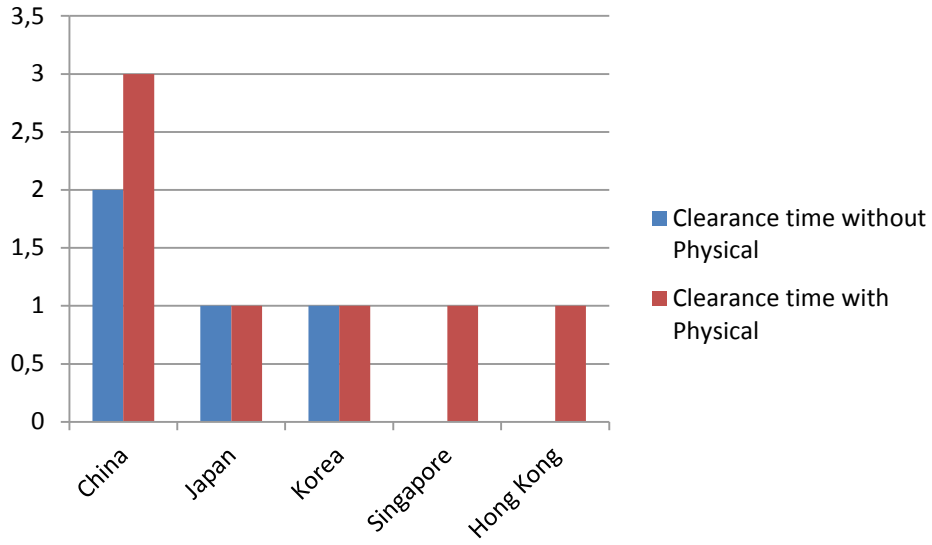


**Figure 17.** Comparison of average clearance times.

As seen in Figure 17 customs clearance wastes the most time in China, both in clearances with and without physical inspection. Singapore and Hong Kong have the most efficient customs procedures as clearance takes mostly under one day. Hong Kong is considered as a free trade area and Singapore's customs are highly efficient. Hence both are currently the largest logistic and trading hubs in Asia.

### Cost Comparison

In cost comparison we compare basic statistics like average warehouse rents, income, and logistic costs. This has the purpose to give a general overview on the price levels of each country. Figure 18 presents a comparison between the annual rent averages in US Dollars per

square meter per annum and the average monthly wages in US Dollars. The left Y-axis represents the rent and the right the wages:

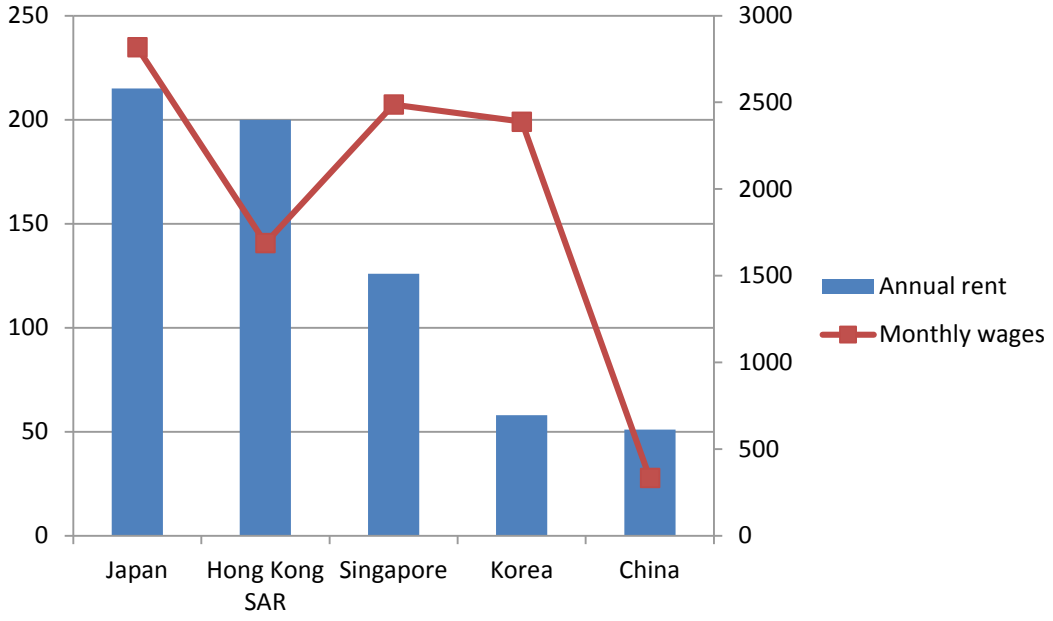


**Figure 18.** Comparison of average annual rents and monthly wages.

As seen in Figure 18 Japan and Hong Kong have the highest rent prices. Compared to China with the lowest average rents, Japanese rents are almost four times higher. Although Hong Kong has the second highest average rents, the annual wages are relatively low compared to Japan, Singapore and the Republic of Korea which are the countries with the highest income. The average monthly wage in Hong Kong is over 1000 US Dollars lower than in Japan and around 700 -800 US Dollars lower than in Singapore and the Republic of Korea. China has still by far the lowest average monthly wages with a little over 300 US Dollars per month.

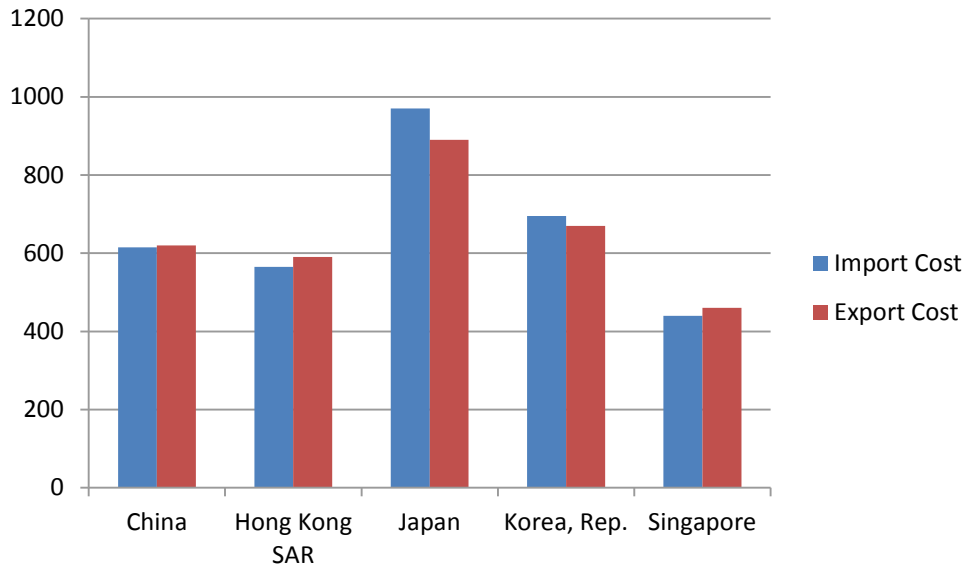


**Figure 19.** Comparison of average logistic costs in US Dollars for import and export.

As seen in Figure 19 the average costs for the import and export of a 20-foot container are relatively similar. However between these countries Japan is once again the most expensive with import costs being almost 1000 US Dollars and export costs around 900 US Dollars. China and the Republic of Korea have costs around 600-700 US Dollars where as Hong Kong's costs are in the region between 550-600 US Dollars. Singapore has the lowest logistic costs with import costs being 440 and export costs 460 US Dollars.

### Installed base

The installed base is evaluated in Chapter 4. As seen ABB China has by far the most allocated vessels with 47 Azipods and Japan the second most with 4 Azipods. Hence the demand for spare parts is statistically the largest for Chinese customers.

### Overall Logistics and Trade Index

As seen in Chapter 3.1 Singapore ranks the highest in the World Banks report on logistic performance among the compared locations. In addition according to the *Global Enabling Trade Report of 2014* Singapore (1st) and Hong Kong (2nd) rank globally highest in the comparison of trade effectiveness in terms of market access, border administration, infrastructure, and operating environment.

### Evaluation and Alternative Model

The biggest challenge of the region is that China has the largest installed base but the most difficult customs and border regulations. One solution is to separate this region into two parts: China and the rest of the region. China would establish its own warehouse serving the installed base in China and a regional warehouse in another country would serve the rest of the region.

The regional warehouse should be established in the most efficient and cost effective location of the region which is clearly either Singapore or Hong Kong. Both rank the highest in global trading and logistic rankings. In addition Hong Kong is considered a free trade area and Singapore has free trade agreements with all of the defined countries to reduce customs barriers and tariffs.

Both Hong Kong and Singapore can provide spare parts urgently to the entire region except China. Additionally Chinese spare parts are mainly purchased locally which also support the solution of separating China from the rest of the region. Hence we suggest a model presented in Figure 20 which is based on the logistic factors presented. The red dots in the figure indicate the warehouse locations.

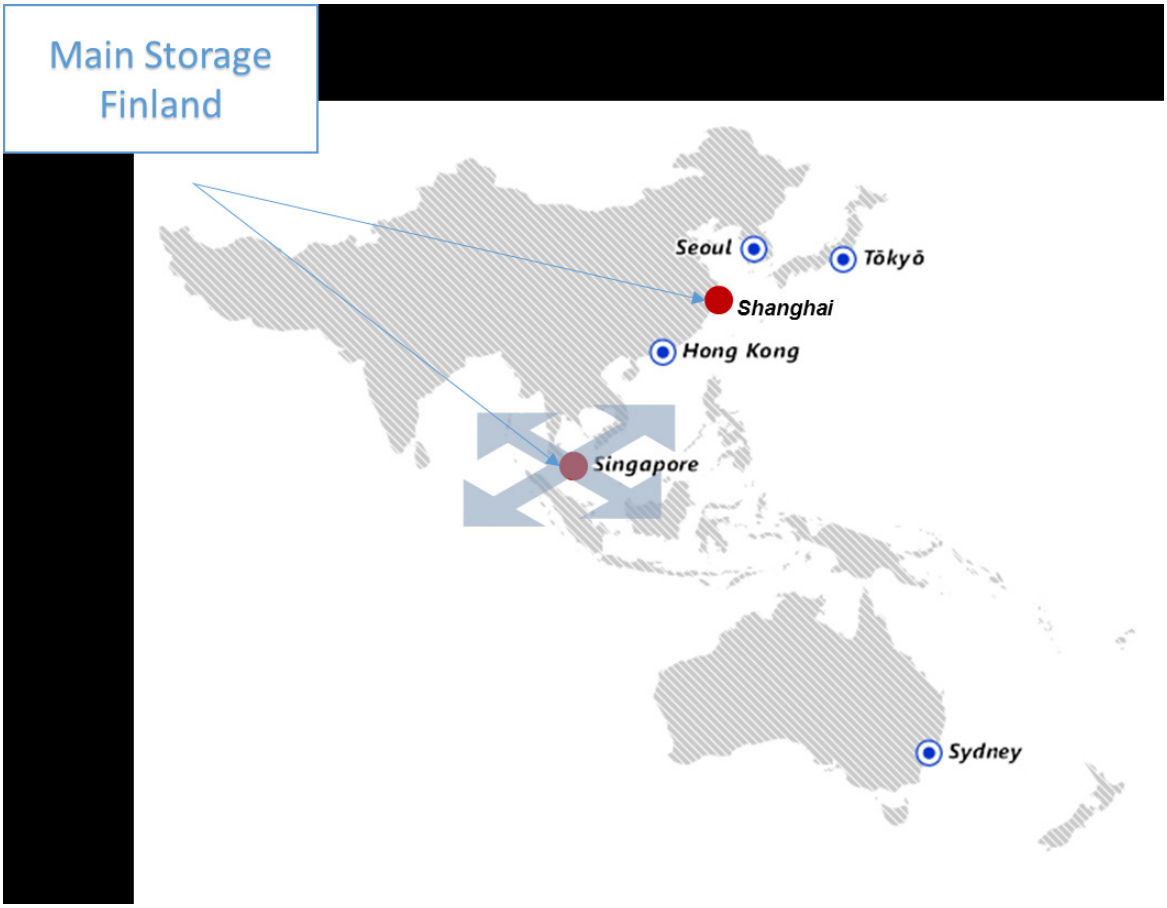


**Figure 20.** Locations of the warehouses and principle of goods movement.

The principle would be that there would be two warehouses, one in Shanghai and another in Singapore. The warehouse located in Shanghai would be owned by ABB China and parts for the Chinese installed base would be stored there. This warehouse would be a non-bonded solution and could be managed by the ABB China's Service and supported by the C-type Azipod production facility in Shanghai. Additionally parts could be continued to be purchased mainly locally. A standard factory or warehouse presented in chapter 5.1.4 could be established as the spare parts warehouse.

The benefit would be that Chinese customs barriers would hinder only in the rare cases where parts are sent from the main storages in Finland. The challenging domestic logistic would also not interfere with deliveries to other countries and would be easier to manage by the local staff with knowledge and experience in the field.

We suggest in this model to establish the regional warehouse in Singapore. Singapore ranks the highest in logistic performance and it has the lowest average logistic costs. Singapore is chosen over Hong Kong as there is already a strong foundation for ABB Marine in Singapore. Expertise is closer by and the establishing could be done in cooperation with the local staff. Additionally Singapore is a busy port for cruise vessels and the Sunshine projects will be operating in the area.

Since cruise vessels operate in almost every country's waters and ports the logistic efficiency is highlighted. Singapore could provide the entire area urgently as customs are ranked the most efficient and tariffs and trading fees are also extremely low. Singapore is additionally a politically stable country with no affecting political tensions in the area.

In Singapore warehousing can be accomplished with bonded solutions. These are so called zero-GST warehouses (zero Goods and Service Taxes warehouses) approved by the Singaporean government which can be located anywhere in Singapore and enjoy the same principles for re-exporting products as the FTZs presented in this thesis. (Singapore Customs, 2013)

The availability of spare parts could be further improved by having small buffers in countries with installed base. In the case where gas is transported from Russia to Japan this fleet could be supported with a critical spares buffer warehouse in either Japan or in the southeast coastal area of Russia. Japan's customs can be challenging and in extremely urgent cases with downtimes of systems leading to extremely high losses the safest plan is to have availability to some extent built in Japan.

The challenging part, similar to the case where a regional warehouse located in China, is the ownership of the warehouse and the parts and thereby the inventory control of parts. An effective way to improve global and regional availability would be to have all the ABB offices have an integrated material management system. If local offices could directly see in their system the inventory, the risk of communication problems and loss of time would be lowered.

### 5.2.1 Comparison of the Models

The benefits of having a regional warehouse centralized in China are first and foremost the investment costs as China requires less investment and overall cost level is lower. One centralized solutions can also be easier to manage than several warehouses. In addition ABB Robotics recently opened up operations in the Shanghai FTZ area, hence knowledge and experience could be utilized inside the company. Furthermore the ABB's C-type Azipod production facility is located in Shanghai which could be beneficial regarding technical support.

On the other hand the model of establishing a regional warehouse in the most efficient location Singapore minimizes the risks of issues with deliveries and customs. Average logistic costs are in Singapore low and ABB Marine is already strongly represented which would add additional technical support. Customs barriers are low in Singapore and procedures efficient. Agreements with most countries in Pacific Asia to reduce customs tariffs and barriers improve the trade efficiency further. However to cope with Chinese vessels parts would have to be imported to China through Chinese customs, hence an additional local storage for Chinese customers would be the most efficient way to improve availability in the entire region.

Geographically Shanghai is better located to serve the East Asian market with Japan, Hong Kong, and the Republic of Korea closer to where ferries, cargo and LNG vessels operate. On the other hand Singapore has the advantage in the South East Asian area with also Australia being closer by, both of which are popular routes for cruise vessels.

Singapore and China both offer the utilization of bonded warehousing which can be seen as an advantage for re-exporting goods. China offers the solution of a hybrid model where the separation of the parts is relatively simple due to the distribution of Azipod types in the region. Singapore on the other hand could hold all parts in the bonded area as the installed base is domestically low. However as the tariffs and customs barriers are low the bonded area is not a necessity as managing and controlling it can require a lot of effort and high expertise.

Dry dockings are increasing in Asia and both locations Singapore and Shanghai host dockings. However as dry dockings can be planned further ahead this comparison is based mainly on critical parts and urgent shipments. Of course dry dockings tend to need also urgent shipments but these can be considered in this comparison as urgent individual spares shipments as these shipments contain mainly only few parts.

# 6 Conclusions

## 6.1 Essential Results and Observations

One of the essential results of this thesis is that the Pacific Asia region can still be roughly divided into two regions: China and the nearby countries. This has the effect that whichever solution is chosen China has to be managed individually or the other markets have to be adjusted to China's challenges.

Even though China has made significant developments since joining the WTO, regarding overall logistics, infrastructure, simplicity of doing business, and political stability, China is still behind Japan, Singapore, Hong Kong and the Republic of Korea. However recent developments show that China is investing heavily in improving the needed infrastructure to compete as a logistic hub in the region.

In terms of relevant factors for this thesis the biggest difference are the customs barriers, which were highlighted also in the interviews. Importing and exporting is considerably delayed by Chinese customs compared to the other countries in the defined region. Furthermore China has the highest tariff rates although average rents and salaries are significantly lower than in the compared locations.

Customs barriers can be lowered by utilizing free trade zones. The Shanghai FTZ provides the opportunity to have bonded and non-bonded storage areas and goods can be stored without a time limit. This solution enables the possibility of urgent deliveries into and out of China without goods wasting delivery time from the customs clearance. By utilizing these zones tariff rates can also be avoided for parts exported outside of China.

The Shanghai FTZ has been established in 2013 and regulations are not completely clear. The zone has received critique for applying promised reforms slowly. The negative list is still considered too long and regulations are speculated to be still unclear. On paper the FTZ looks promising and fitting for the needs described in this thesis however it has received criticism of difficult bureaucracy and slow implementations of promised regulations.

Considering doing business in China, the interviews confirmed the statements provided in recent literature about personal relationships being extremely important. In a project such as establishing a warehouse in China local knowledge is considered vital as negotiations and relationship building can reduce costs in considerable amounts.

In terms of logistic costs, tariffs, delays, and quality, Singapore and Hong Kong provide the best foundation to serve as a logistic hub for the East Asia region. The infrastructure and delivery quality in Japan is considered also extremely high however Japan is investment wise more expensive than Singapore and Hong Kong. Japan has higher tariffs, average logistic costs, rents, and salary. The customs in Japan are also considered to be less efficient in terms of clearance times and simplicity. Singapore was chosen for the alternative model due to its most efficient logistics and strong ABB Marine presence.

## 6.2 Evaluation of Results

The results do not offer any significant surprise. The common consensus in the field seems to be that China is behind the modern neighboring countries in terms of logistics competence however it is making constant efforts in catching up by making policies more transparent and opening up the markets. The rapid developments in China's economy and policy changes also make the reviewing challenging as improvements and new regulations are set up on a fast pace.

The results of the interviews regarding cultural characteristic of Chinese business confirmed that cultural differences are still relatively strong. Through globalization and multi-global companies operating all over the world, it would be imaginable that business cultures move into a more uniform way of handling business, however the interviews highlighted also that local business knowledge is essential for succeeding in the Chinese market.

The interviews indicated also that the myth of Chinese vendors producing low quality products is long gone. Of course in a country as big as China there is a possibility to confront all kinds of issues, but the message of the interviews was that they were satisfied with Chinese vendors. The growing economy in China puts more competitive pressure on the market and

vendors, and especially smaller vendors see the possibility to work with multi-global companies as a great opportunity. By co-operating with suppliers there is no problem in reaching the desired quality requirements. The common opinion among the interviewees was that in today's market there is not much difference in the issues faced with Chinese vendors compared to ones faced with European vendors.

The fact that the domestic logistics in China were highlighted as the biggest challenge is not surprising as logistics investments and efforts of improvement are still relatively new. As international operators were not allowed in China before the year 2007 it is clear that China is behind modern criteria of basic logistic standards and requirements that European based companies are used to.

The political stability and dynamics of the entire region raises still some questions which were current topics during the thesis. Contra China protests in Hong Kong were beginning to gather at the end period of the thesis writing which may affect the bilateral relationship in the future. Also the heads of China and Japan met for the first time during their reign in the APEC-meeting in November 2014. It seems that tensions are mostly political and history related conflicts. Nevertheless, according to studies and interviews, the business between international companies in the region is not affected by the tensions.

# 7 Follow-Up Actions and Recommendations

If a warehouse is established the inventories need to be well assessed and planned. This requires making decisions on what service level is desired and how many consumables are seen as added value in addition to the critical spares. At least an indication of the part volumes is needed so that the required storage base can be assessed and as a result possible venues and facilities suggested.

It would also benefit the cause if a more detailed knowledge would be gained about the current state of critical spares on board of the vessels. These inventories are customer owned and therefore not constantly up to date at ABB Marine. This information would benefit the planning of the availability and the requirements for more detailed inventory levels.

To achieve a more systematic approach through the entire supply chain a more transparent approach to material management systems between countries could be suggested. If inventory levels could be seen in all systems the global availability planning between main storages regional storages and buffer storages would be more simple and effective in the bigger picture for ABB Marine Service. Strong country borders cause risk of miscommunication however these are deeply built in the company culture and regulations, which is a challenge that departments have to adjust to.

All in all, as the installed base in the region is still relatively small, it might be worth first seeing the future developments. LNG vessels will be operating more in the Japan area and additionally cruises are increasing in popularity in Asian countries. On the other hand, if strategies are planned ahead and future growth is already taken into account compromise-solutions caused by time pressure can be avoided.

However the Chinese installed base is growing rapidly and domestic availability should already be planned. To bring the project further in China decisions have to be made: will the FTZ be utilized in planning ahead for the future growth of the entire region, or is the domestic market first seen as the only priority.

# 8 Summary

Spare parts supply chain management differs from other manufacturing supply chains, such as work-in-process and final products, in several ways. Spare part inventories exist mainly to keep equipment in the installed base in operating condition hence demand for spare parts may be extremely sporadic which leads to difficulties in estimating demand and planning inventories. Additionally challenges in spare parts logistics emerge mainly due to the combination of large service networks, rigid deadlines and customer heterogeneity.

The installed base in Pacific Asia is growing rapidly especially in China, which put pressure on improving availability of spare parts in the region to maintain a high service level and customer satisfaction. The region is logistic wise challenging because of the differences in logistic efficiency and performance. The customs barriers in China are still the highest with the slowest customs clearance times and highest tariffs however China has by far the largest installed base volume. Regarding overall logistics Singapore and Hong Kong are the most competitive with highly efficient customs, clear regulations, competitive logistic costs, and good infrastructure.

Chinese customs barriers can be reduced by utilizing free trade zones. We propose a solution model where a hybrid warehouse containing a bonded and a non-bonded storage area is set up in the Shanghai FTZ. Spare parts meant for re-export to other countries in the region are not exposed to Chinese customs tariffs and clearance as they are stored in the bonded area. Parts for the domestic market in China are stored in the non-bonded storage leading to short delivery times as parts are already cleared from customs. Additionally domestic purchased parts can be stored in the non-bonded area without customs interference.

An alternative model would be to set up a regional warehouse in Singapore due to its highly efficient overall logistic competence and strong ABB Marine presence. Other countries in the region and foreign vessels operating in Pacific Asia can be easily accessed from Singapore however the Chinese customs still delay the access to China. Therefore we suggest this model to be two leveled, where a domestic warehouse in China would serve the Chinese market and the regional warehouse in Singapore the rest of the region.

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